STUDIES WITH SMALL RIVER MODELS

VOL. 2 OF 2

R. K. DEEPROSE

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THESIS
1959
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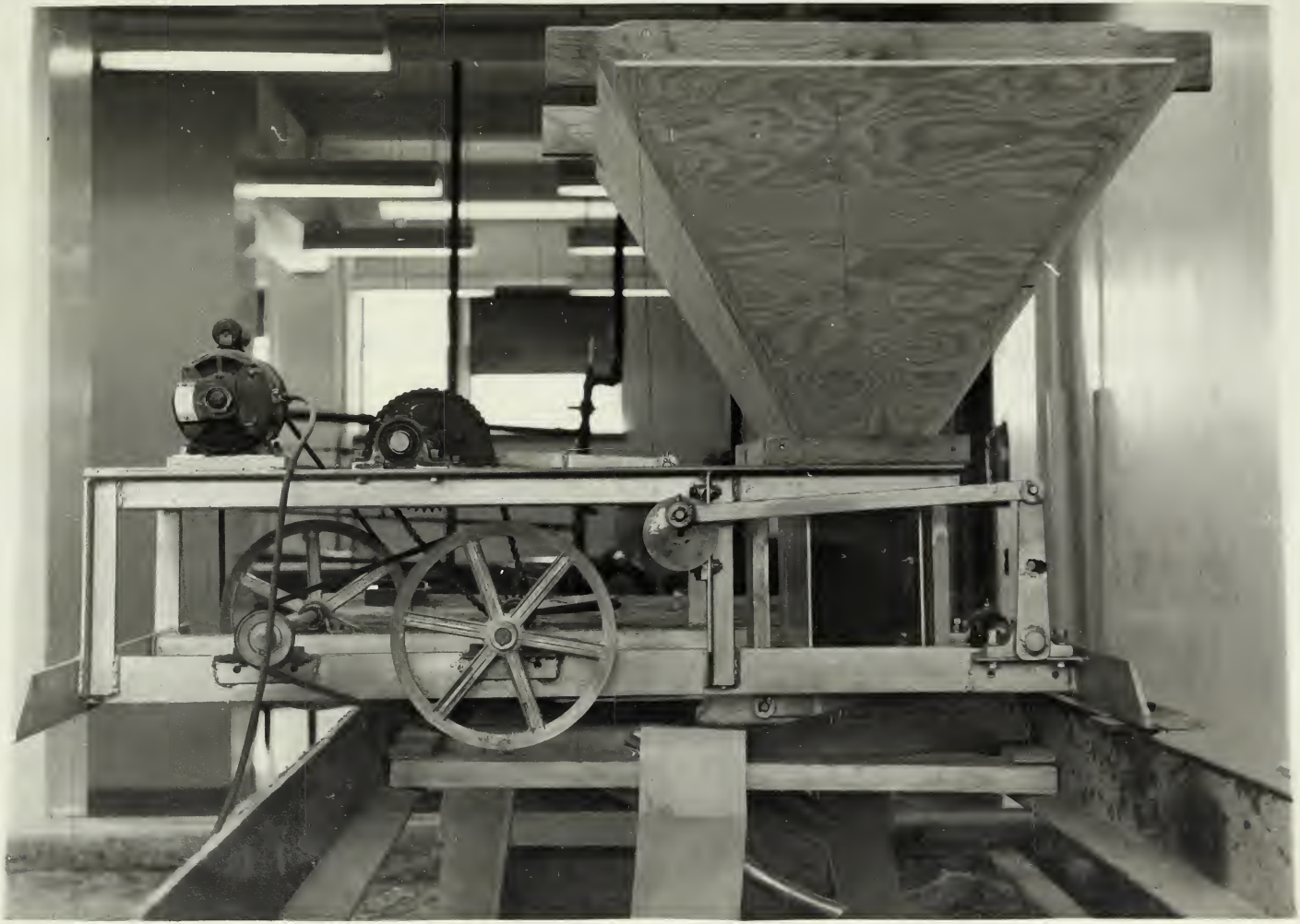


FIG. 1 SAND FEEDER

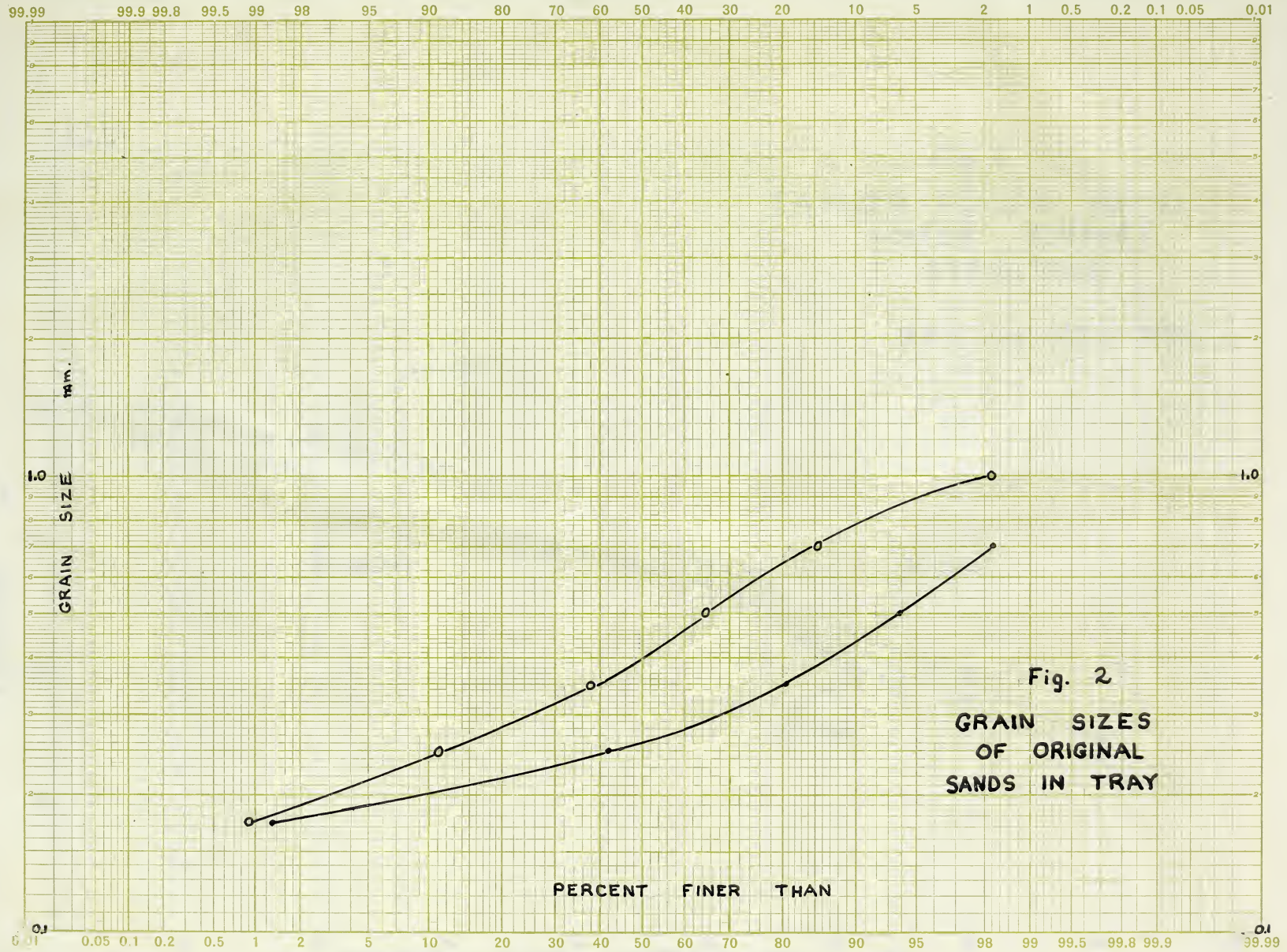


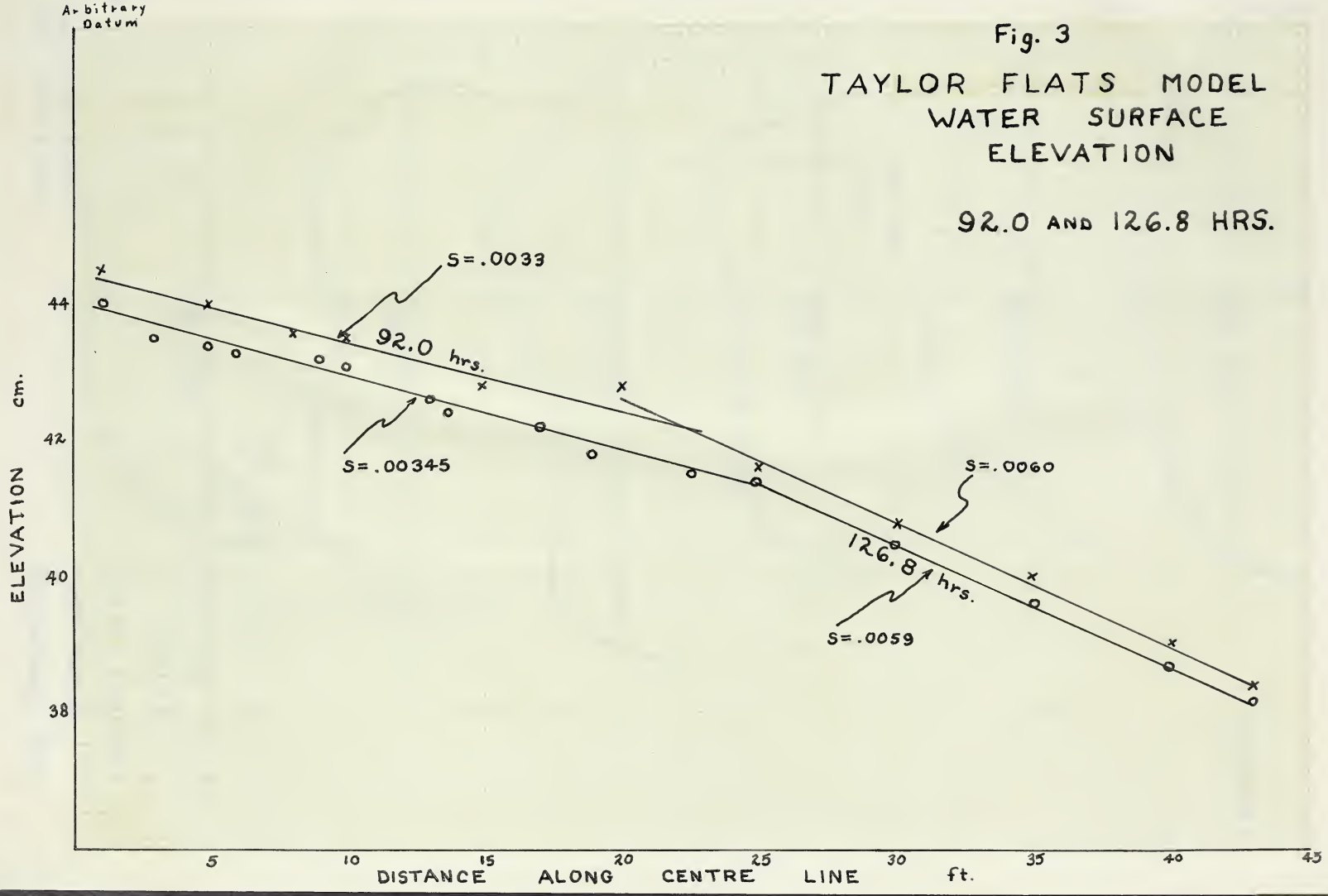
Fig. 2

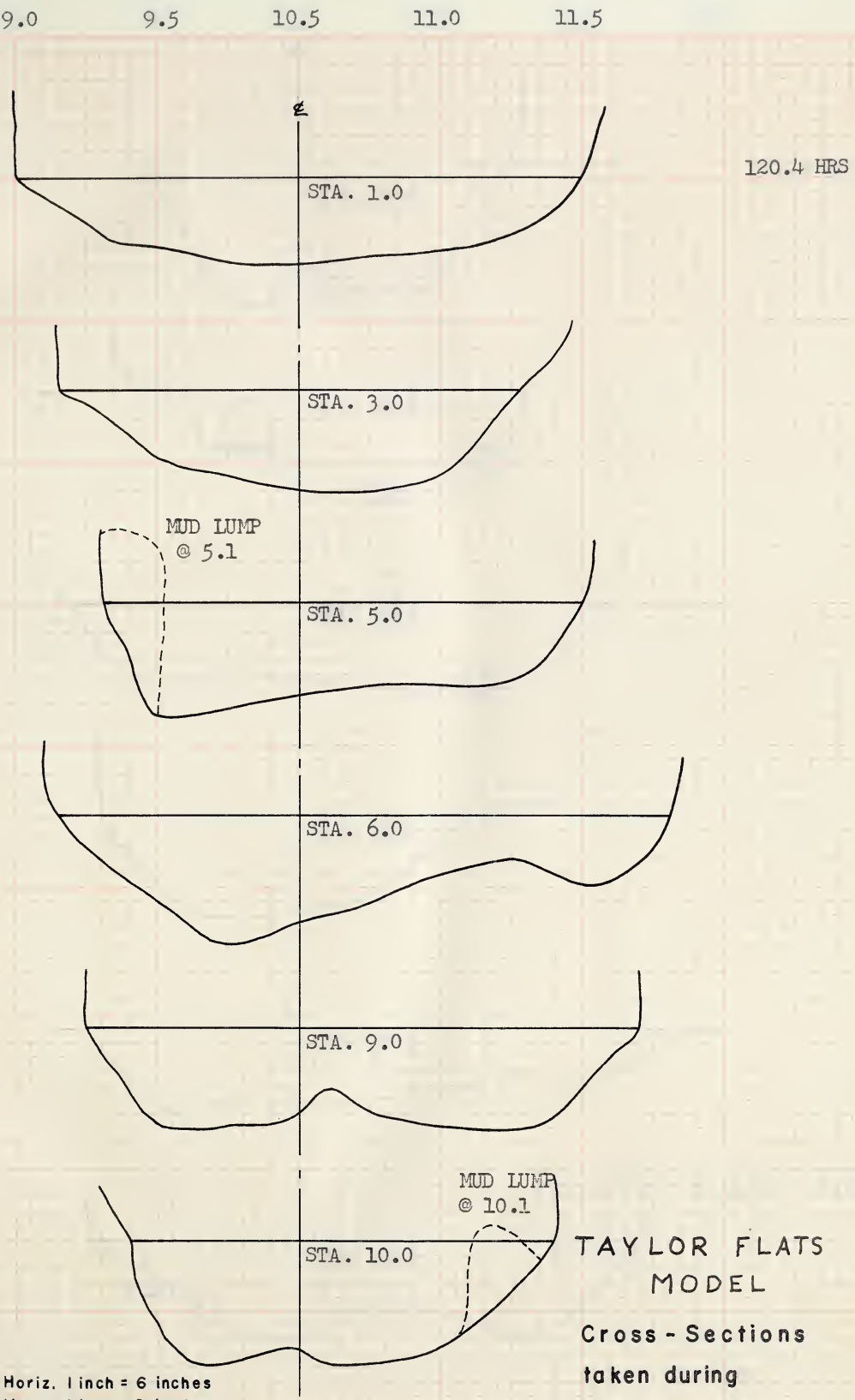
GRAIN SIZES OF ORIGINAL SANDS IN TRAY

Fig. 3

TAYLOR FLATS MODEL
WATER SURFACE
ELEVATION

92.0 AND 126.8 HRS.





TAYLOR FLATS
MODEL

Cross - Sections
taken during
Preliminary Run

Fig. 4

Scales: Horiz. 1 inch = 6 inches
Vert. 1 inch = 2 inches

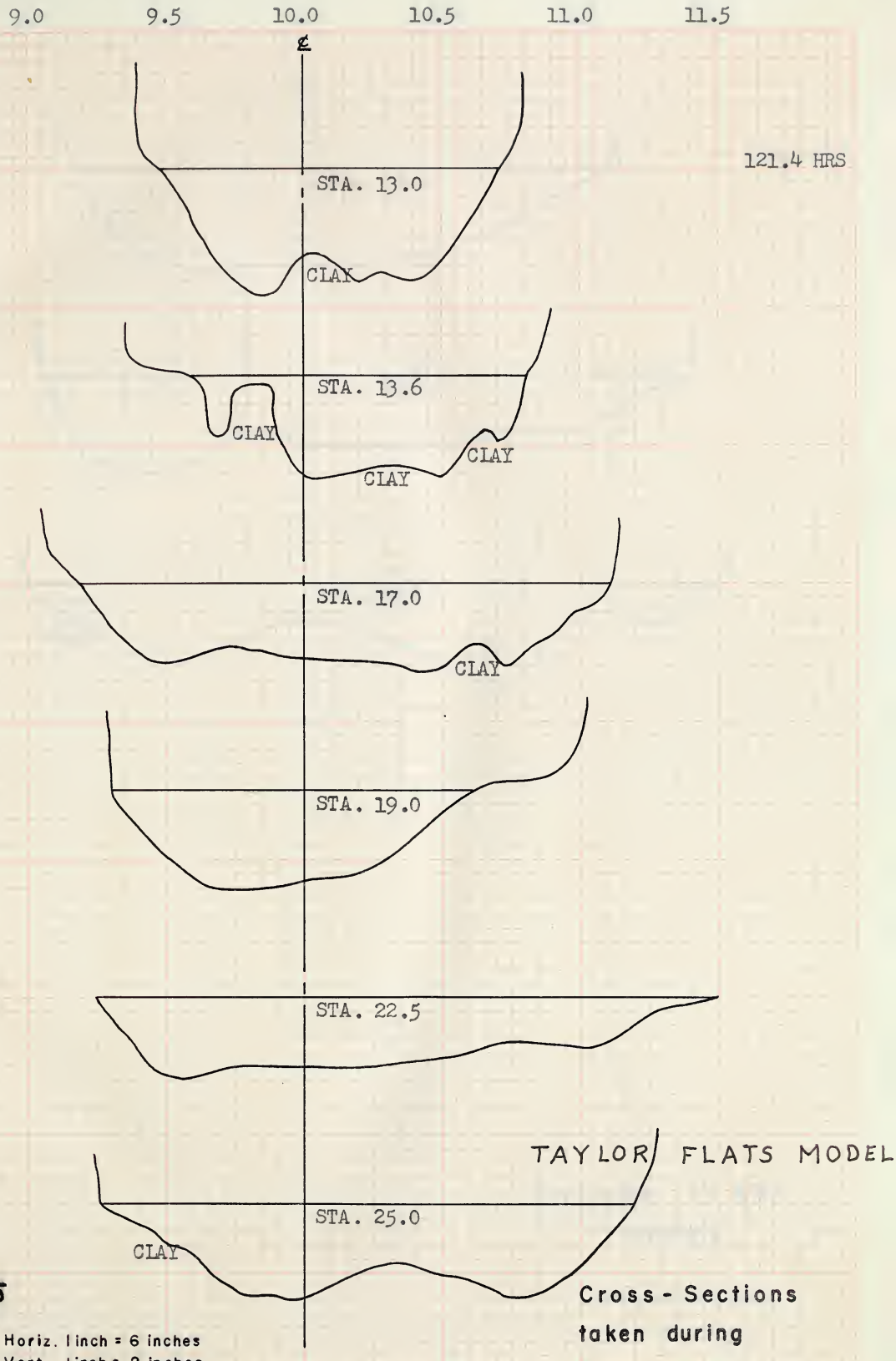
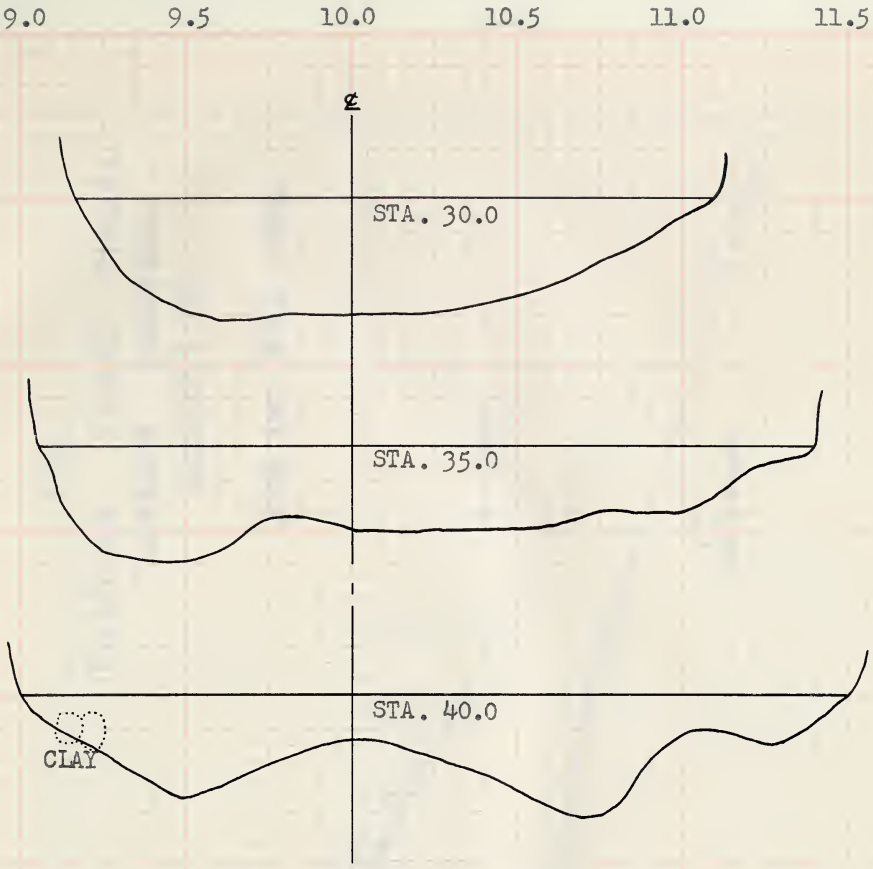


Fig. 5

Scales: Horiz. 1 inch = 6 inches
Vert. 1 inch = 2 inches

Cross-Sections taken during Preliminary Run



TAYLOR FLATS
MODEL

Cross-Sections
taken during
Preliminary Run

Fig. 6

Scales: Horiz. 1 inch = 6 inches
Vert. 1 inch = 2 inches

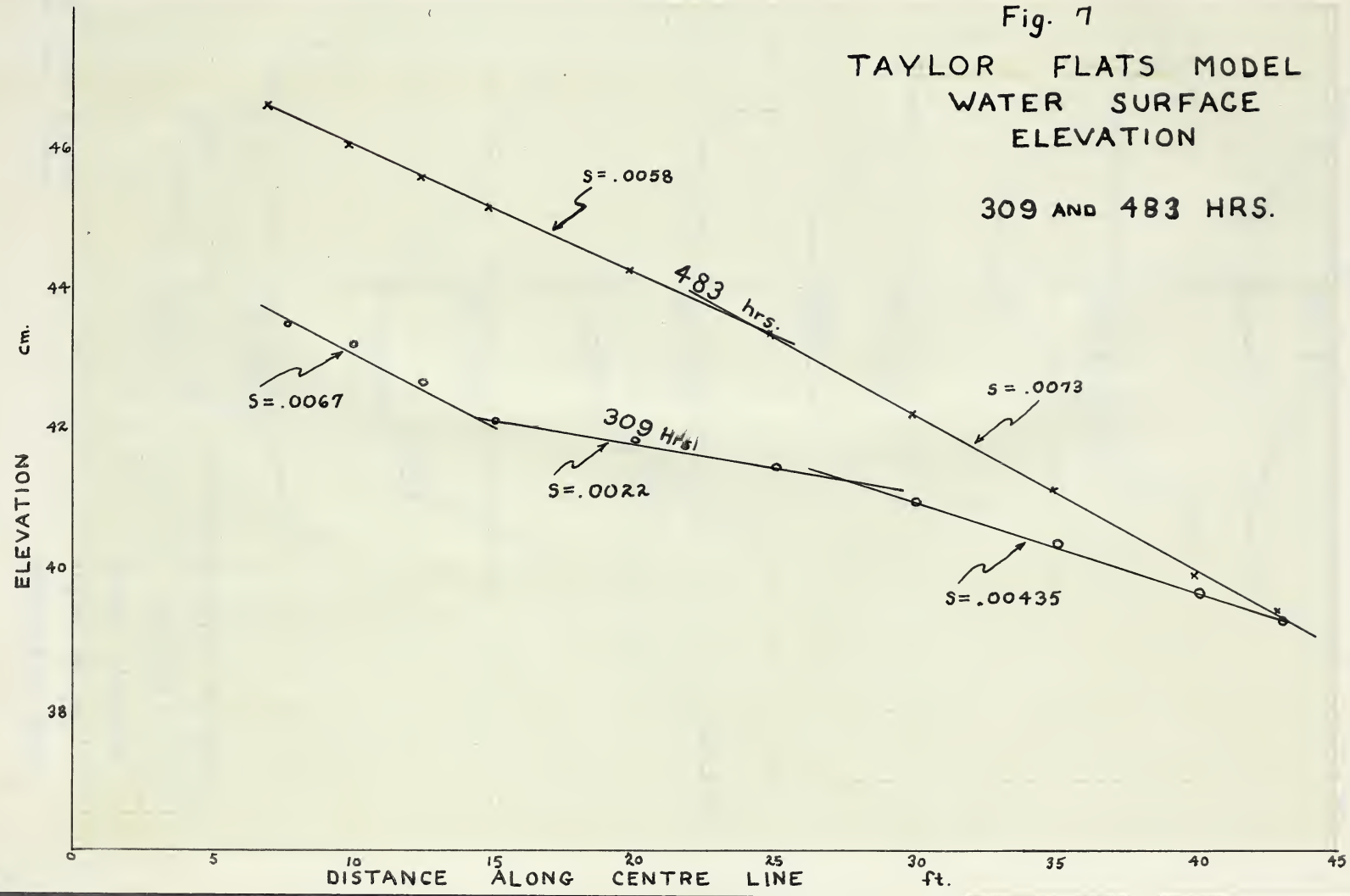
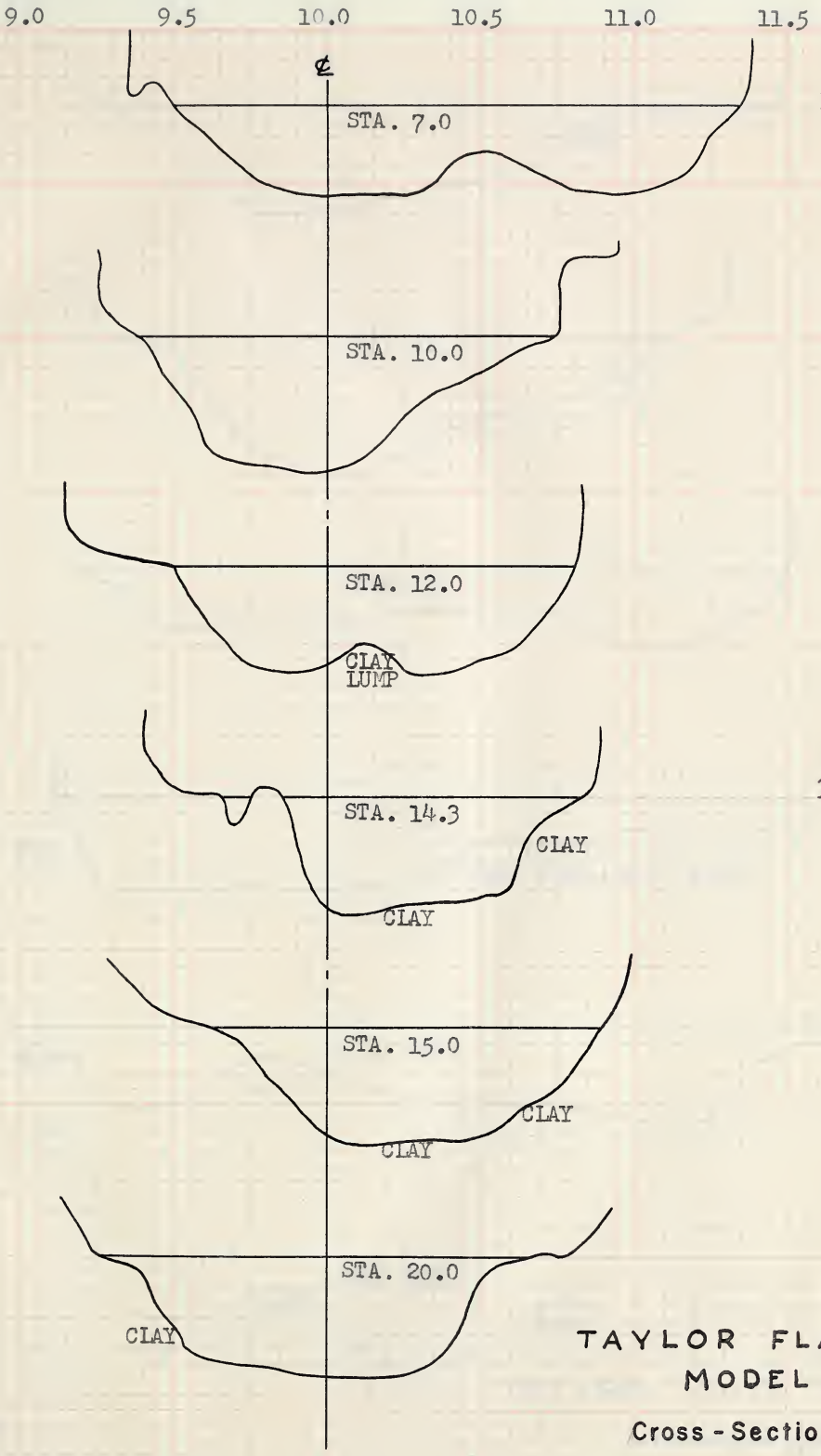


Fig. 7
TAYLOR FLATS MODEL
WATER SURFACE
ELEVATION
309 AND 483 HRS.
S=.0058
483 hrs.
S=.0067
309 Hrs.
S=.0022
S=.0073
S=.00435
ELEVATION cm.
46
44
42
40
38
0
5
10
15
20
25
30
35
40
45
DISTANCE ALONG CENTRE LINE ft.



TAYLOR FLATS
MODEL

Cross-Sections
taken during
Preliminary Run

Fig. 8

Scales: Horiz. 1 inch = 6 inches
Vert. 1 inch = 2 inches

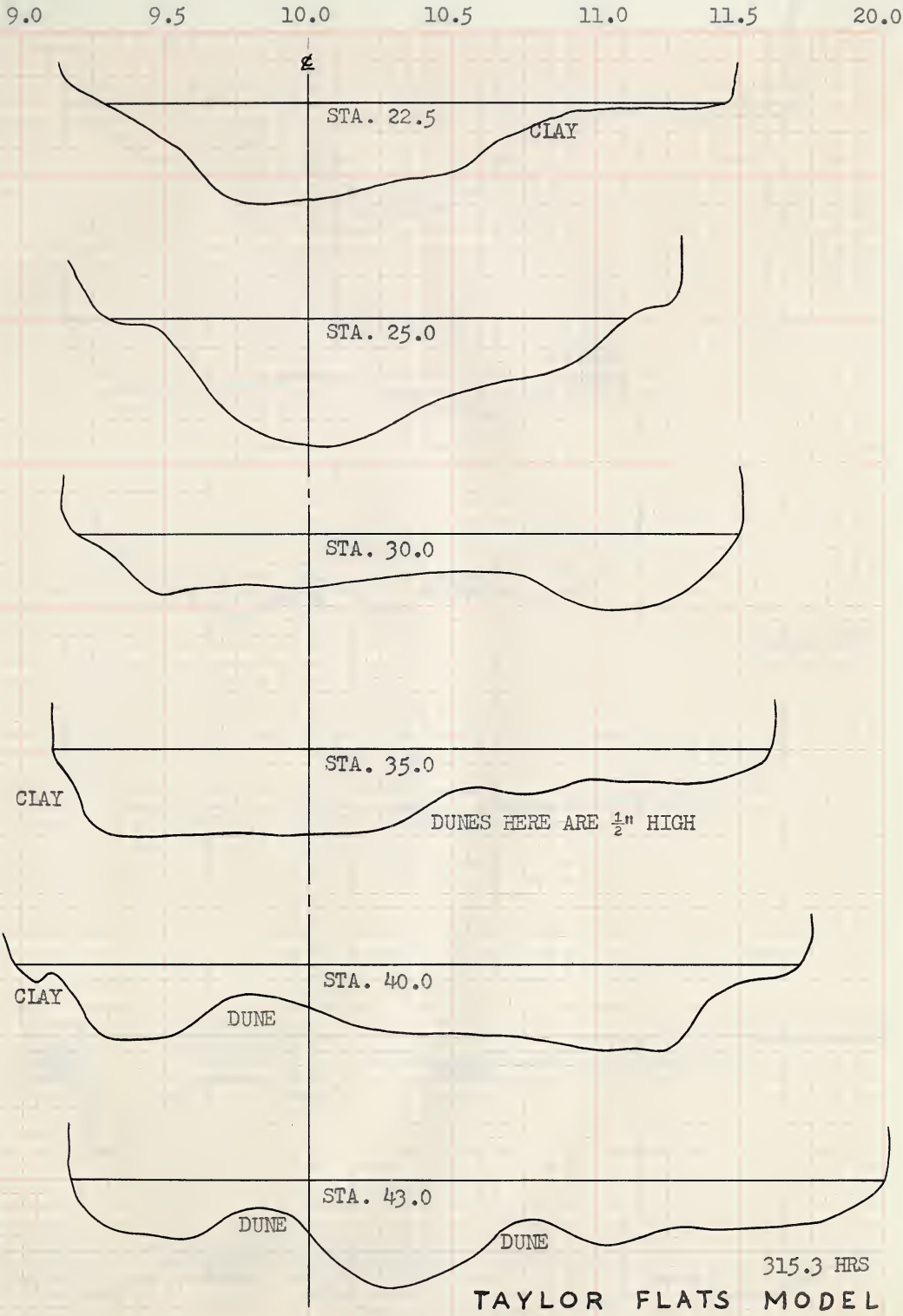


Fig. 9

Scales: Horiz. 1inch = 6 inches
Vert. 1inch = 2 inches

Cross-Sections taken during Preliminary Run

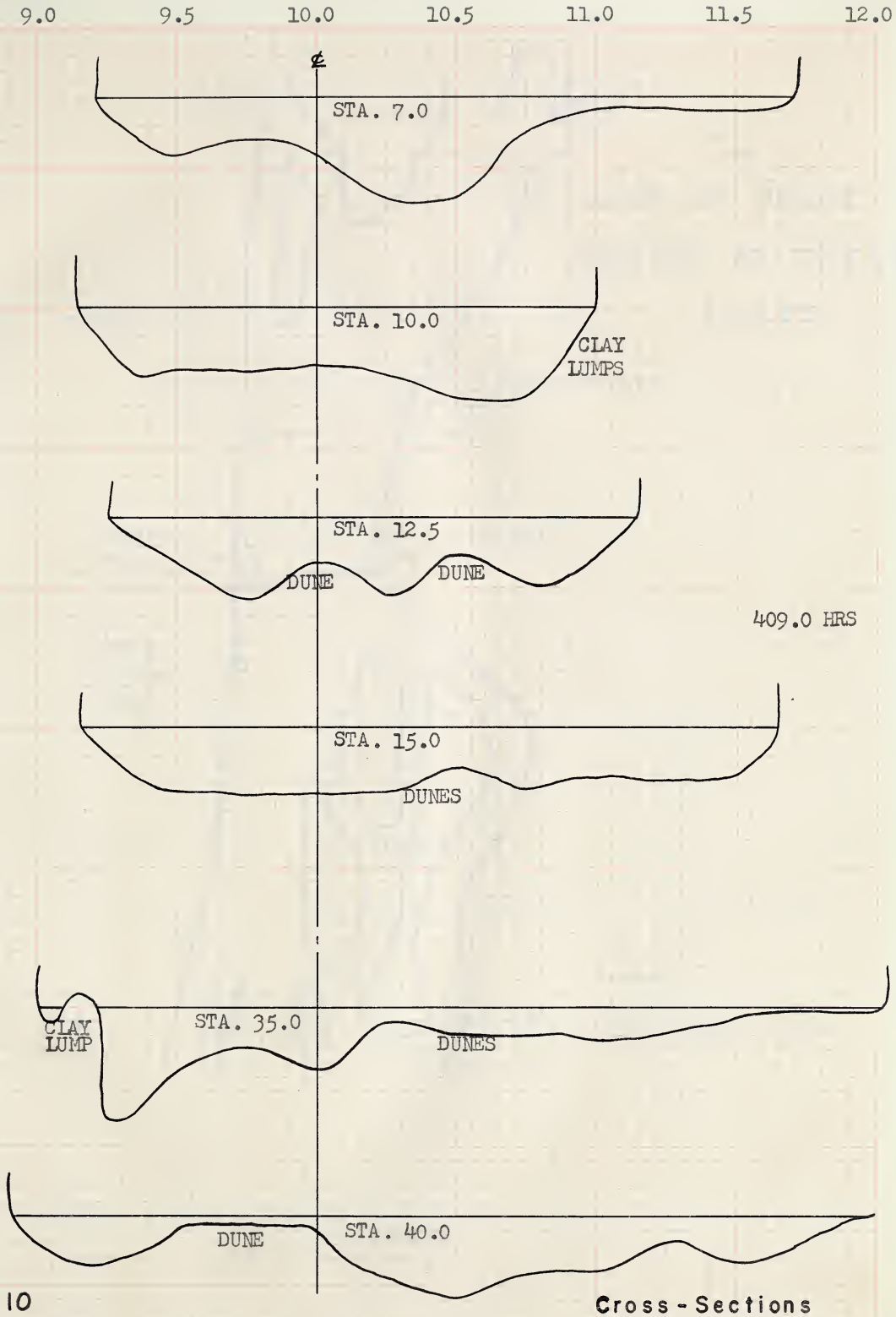


Fig. 10

TAYLOR FLATS MODEL

Cross-Sections taken during Preliminary Run

Scales: Horiz. 1 inch = 6 inches
Vert. 1 inch = 2 inches

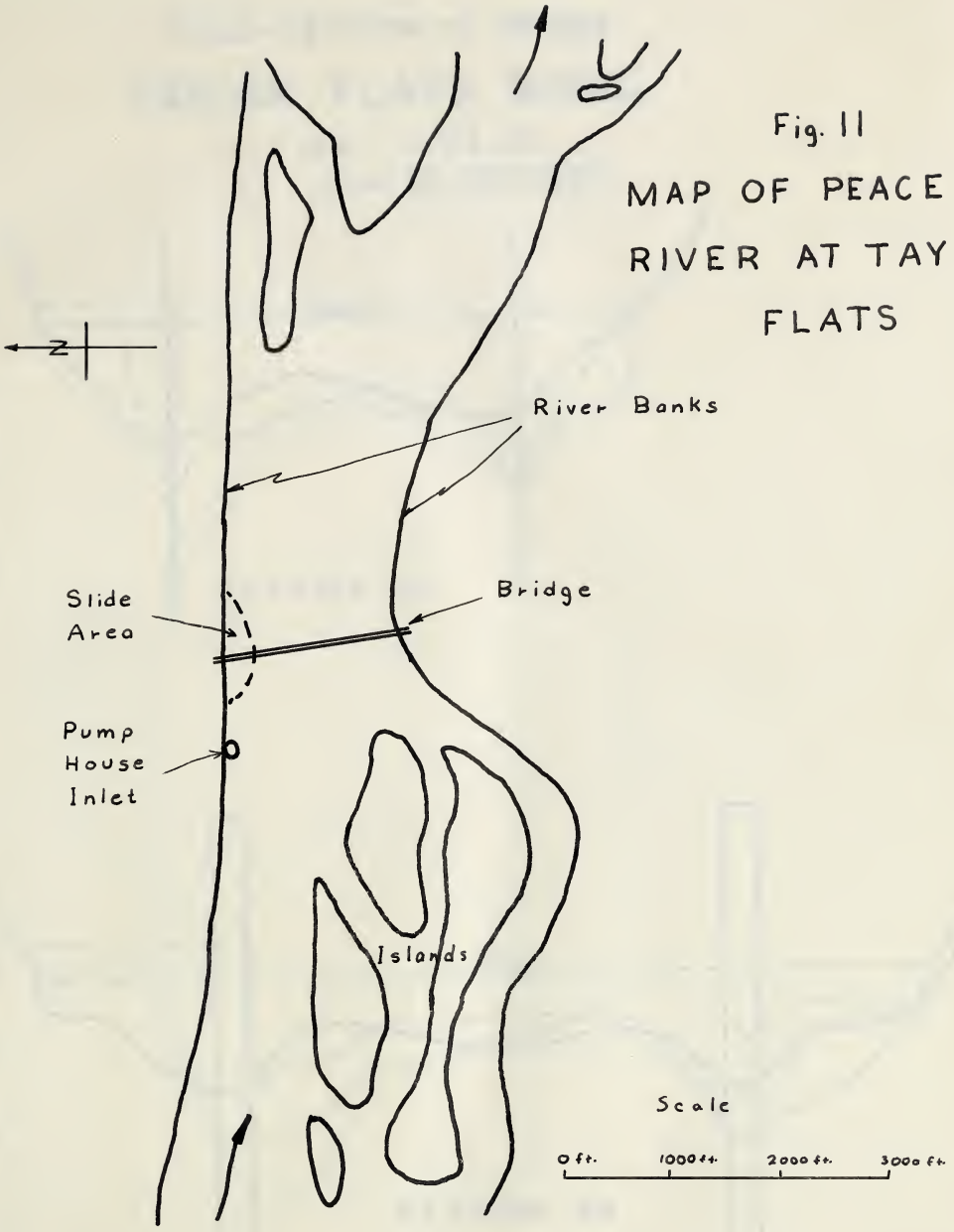


Fig. 11

MAP OF PEACE RIVER AT TAYLOR FLATS

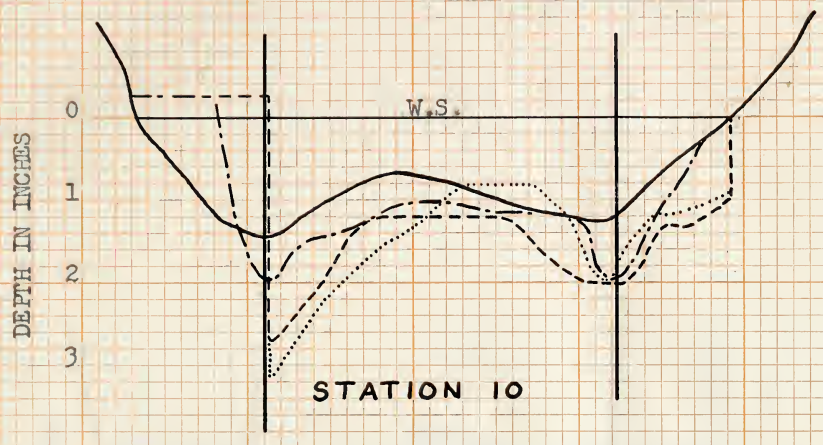
Fig. 12

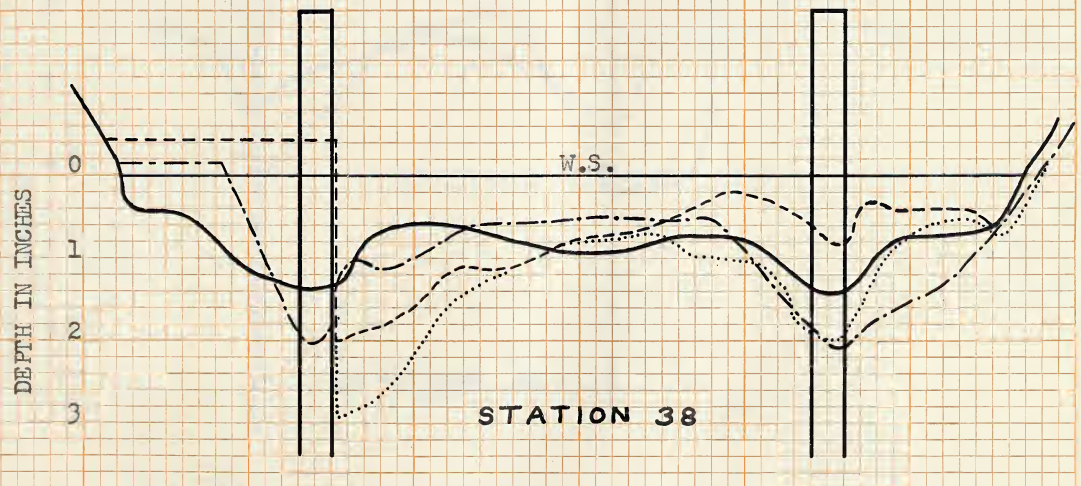
Cross-Sections at Bridge

TAYLOR FLATS MODEL

Flow = 0.09 cfs.

Scales: Hor. 1 inch = 0.5 ft.
Vert. 1 inch = 2.0 ft.





Sand Surface - No slide protection

" " - Slide protection A

" " - " " B (1)

" " - " " B (2)

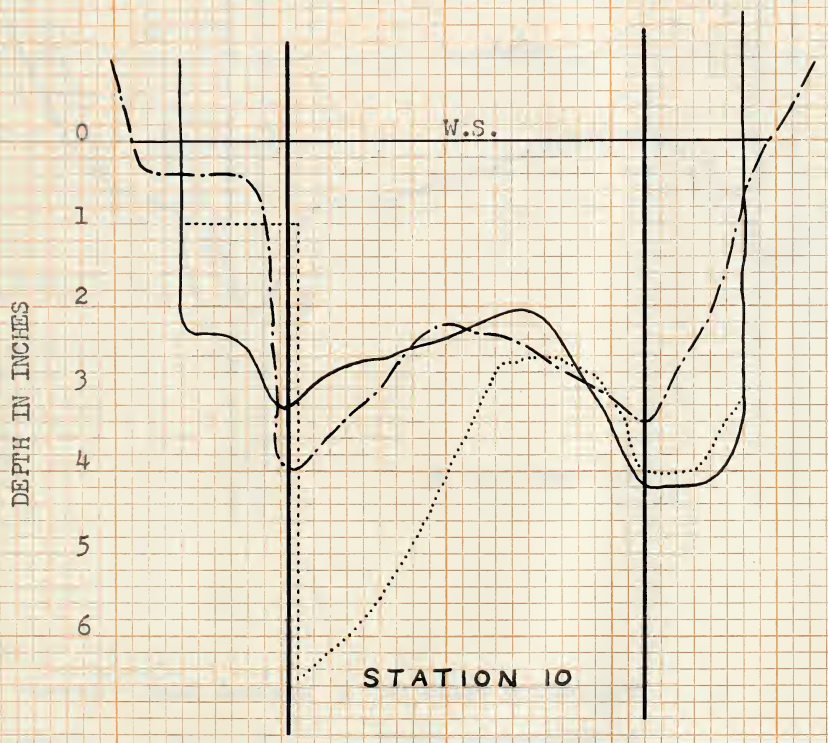
Fig. 13

Cross-Sections at Bridge

TAYLOR FLATS MODEL

Flow = 0.45 cfs.

Scales: Hor. 1 inch = 0.5 ft.
Vert. 1 inch = 2.0 ft.



——— Sand Surface - No slide protection

—·— " " - Slide protection A

····· " " - Slide protection B

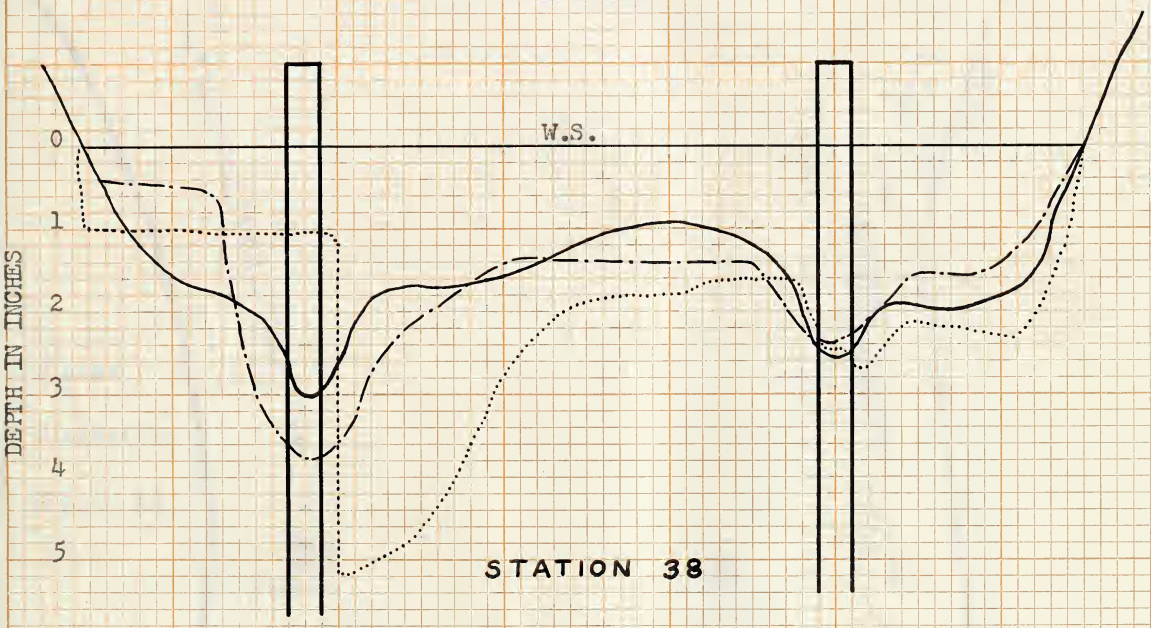
Fig. 14

Cross-Sections at Bridge

TAYLOR FLATS MODEL

Flow = 0.45 cfs.

Scales: Hor. 1 inch = 0.5 ft
Vert. 1 inch = 2.0 ft.



——— Sand Surface - No slide protection

—·— " " - Slide protection A

····· " " - Slide protection B

Fig. 15

PLAN VIEW
TAYLOR FLATS MODEL
Sta. 38
Slide Protection Type "A"

Scale: 1" = 0.5'
Flow: 0.45 cfs

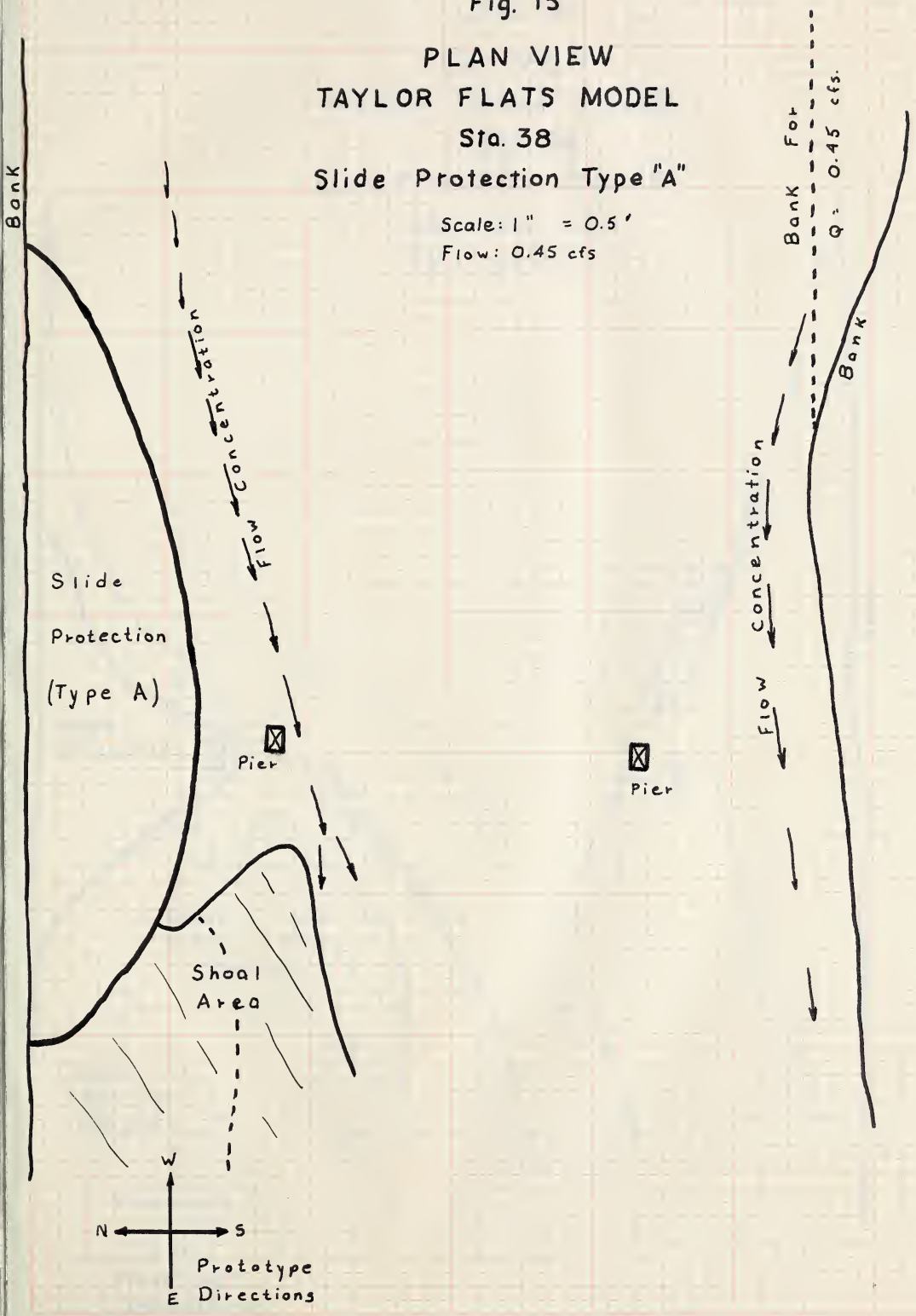


Fig. 16

PLAN VIEW
TAYLOR FLATS MODEL
Sta. 38
Slide Protection Type "B"

Scale: 1 inch = 0.5 ft
Flow: 0.09 cfs.

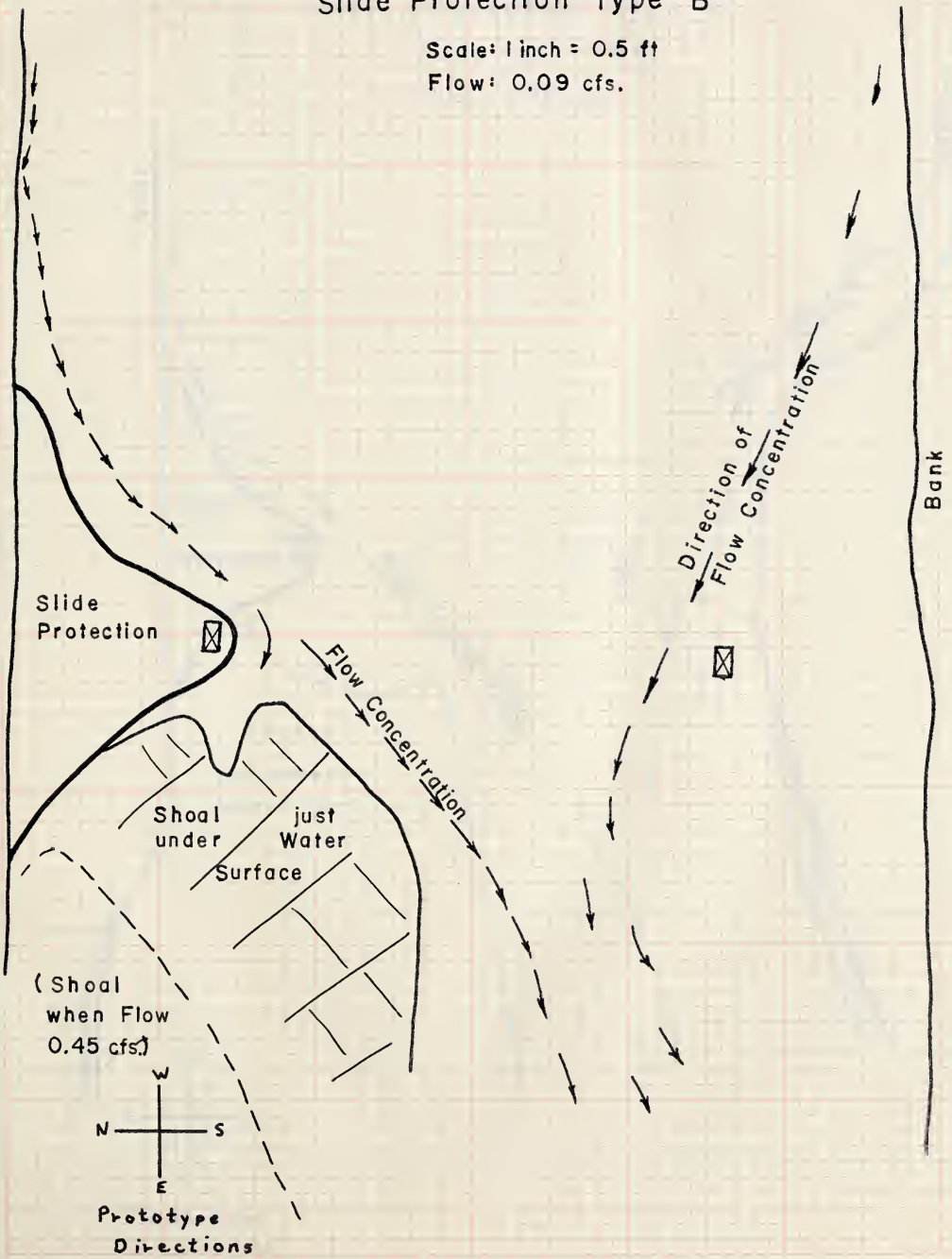


Fig. 17

PLAN VIEW

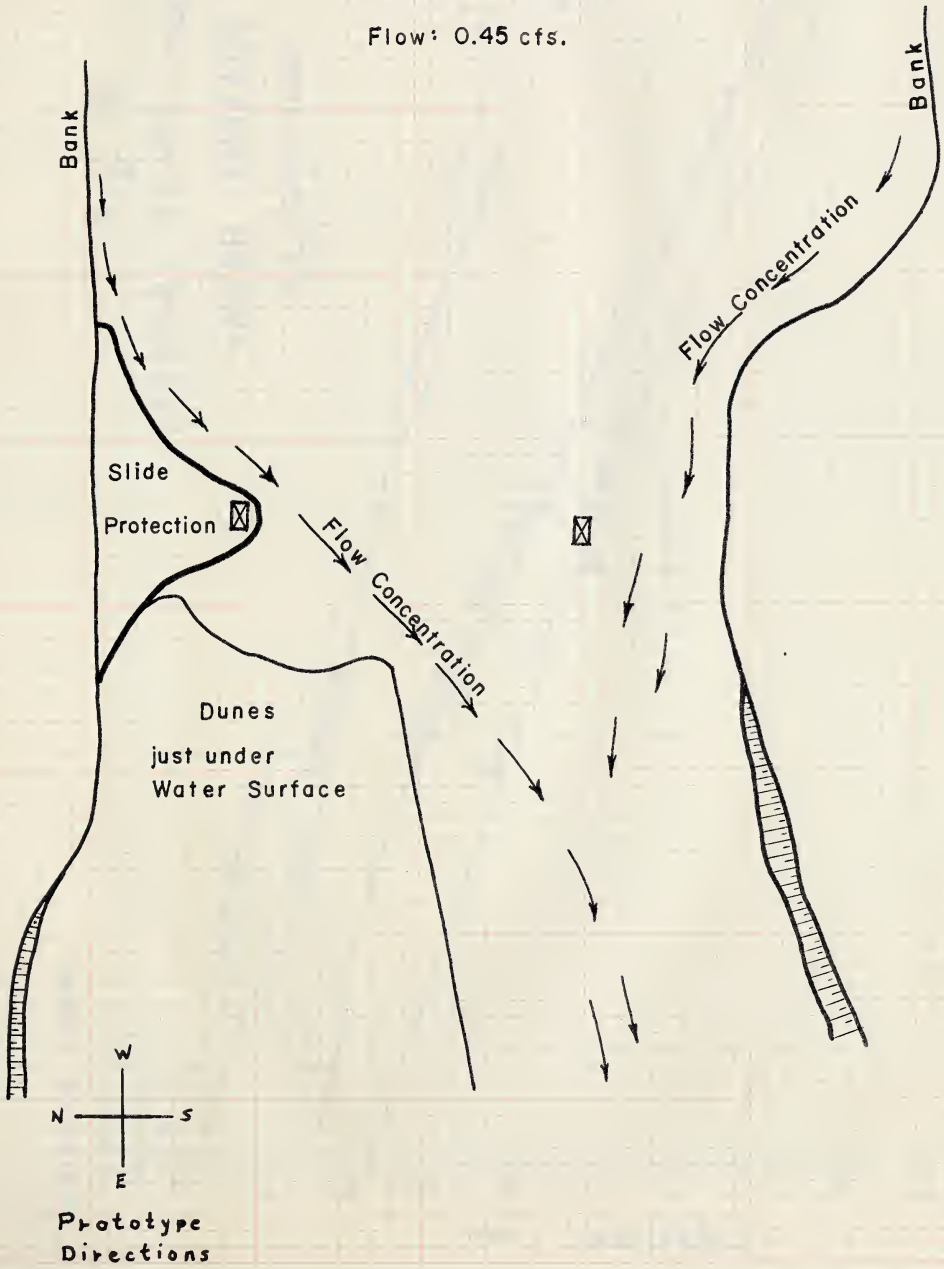
TAYLOR FLATS MODEL

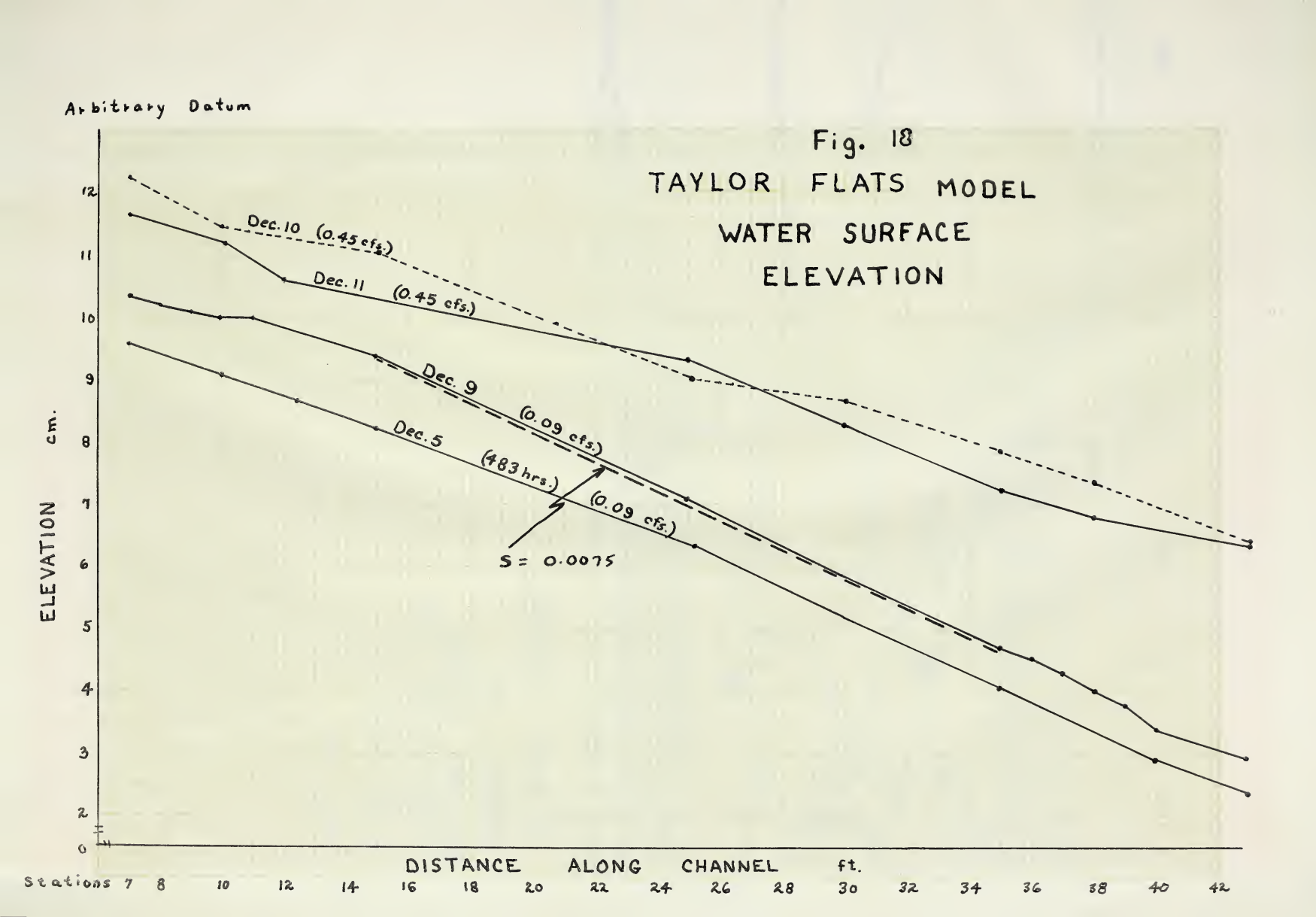
Sta. 10

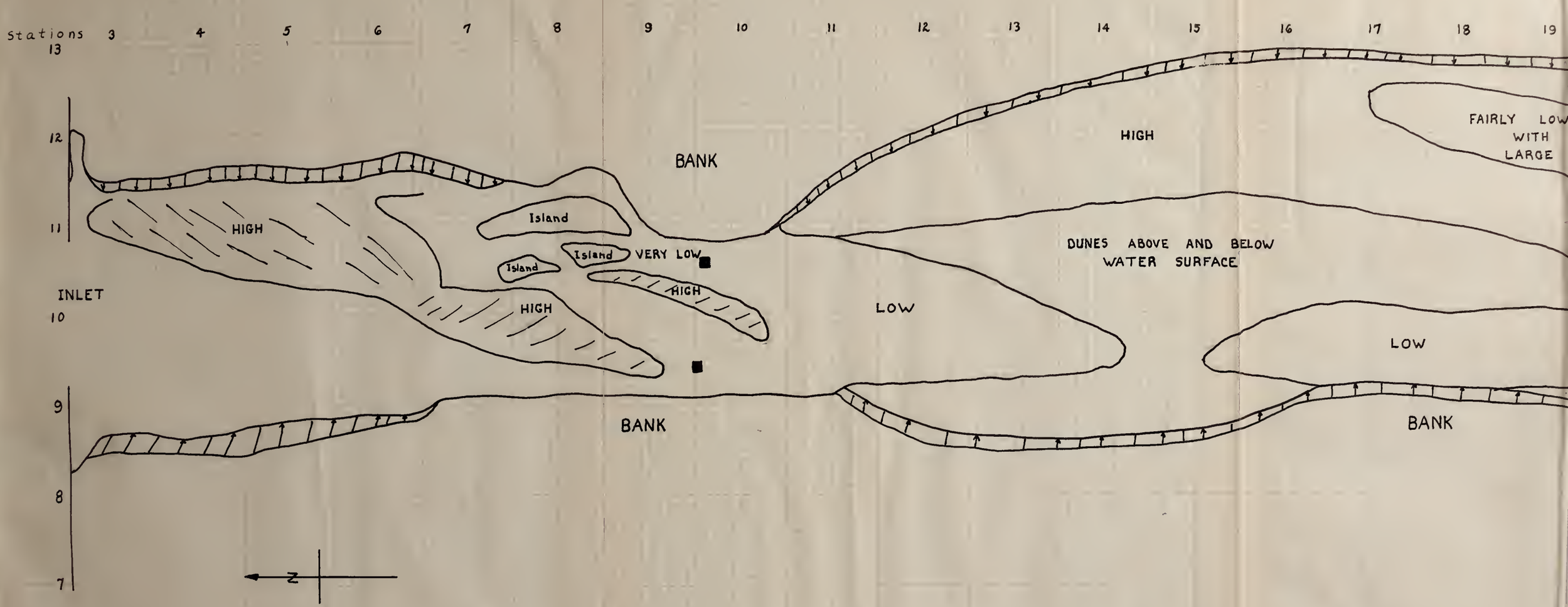
Slide Protection Type "B"

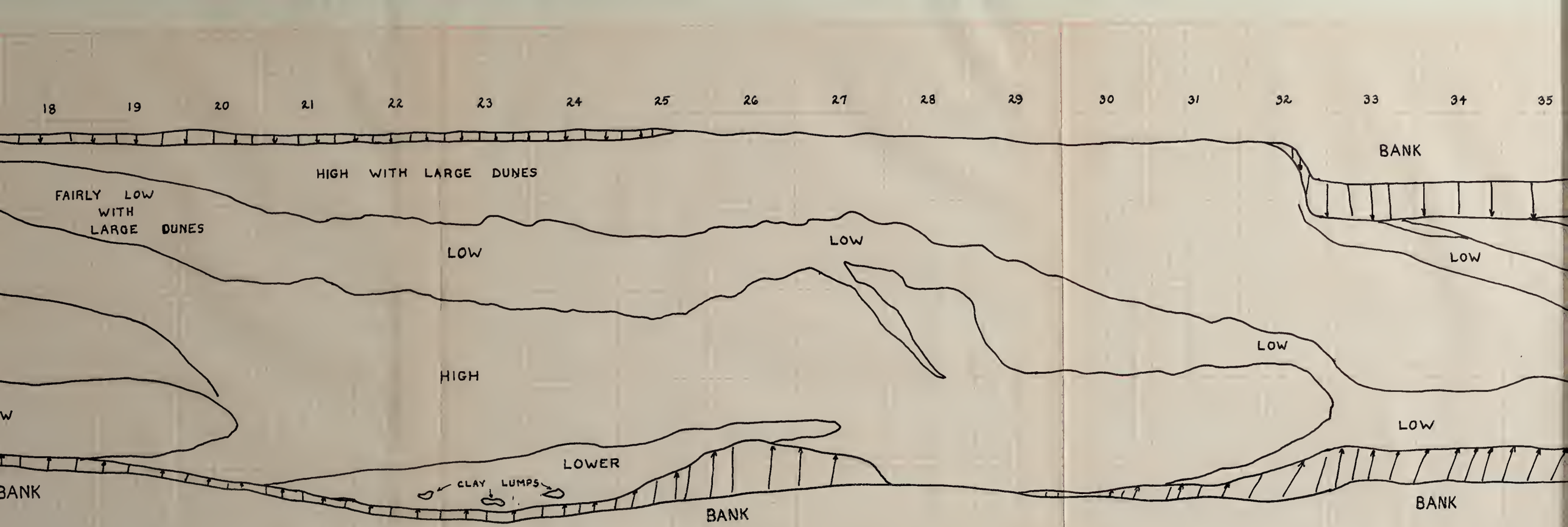
Scale: 1 inch = 0.5 ft.

Flow: 0.45 cfs.




Arbitrary Datum
Fig. 18
TAYLOR FLATS MODEL
WATER SURFACE
ELEVATION
Dec. 10 (0.45 cfs.)
Dec. 11 (0.45 cfs.)
Dec. 9 (0.09 cfs.)
Dec. 5 (483 hrs.) (0.09 cfs.)
S = 0.0075
ELEVATION cm.
12
11
10
9
8
7
6
5
4
3
2
0
DISTANCE ALONG CHANNEL ft.
Stations 7 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Stations 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
13
12
11
10
9
8
7
INLET
HIGH
Island
Island
Island
VERY LOW
HIGH
HIGH
BANK
LOW
BANK
HIGH
DUNES ABOVE AND BELOW WATER SURFACE
FAIRLY LOW WITH LARGE
LOW
BANK
N


18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
HIGH WITH LARGE DUNES
FAIRLY LOW WITH LARGE DUNES
LOW
LOW
BANK
LOW
LOW
HIGH
W
LOWER
CLAY LUMPS
BANK
BANK
LOW
BANK

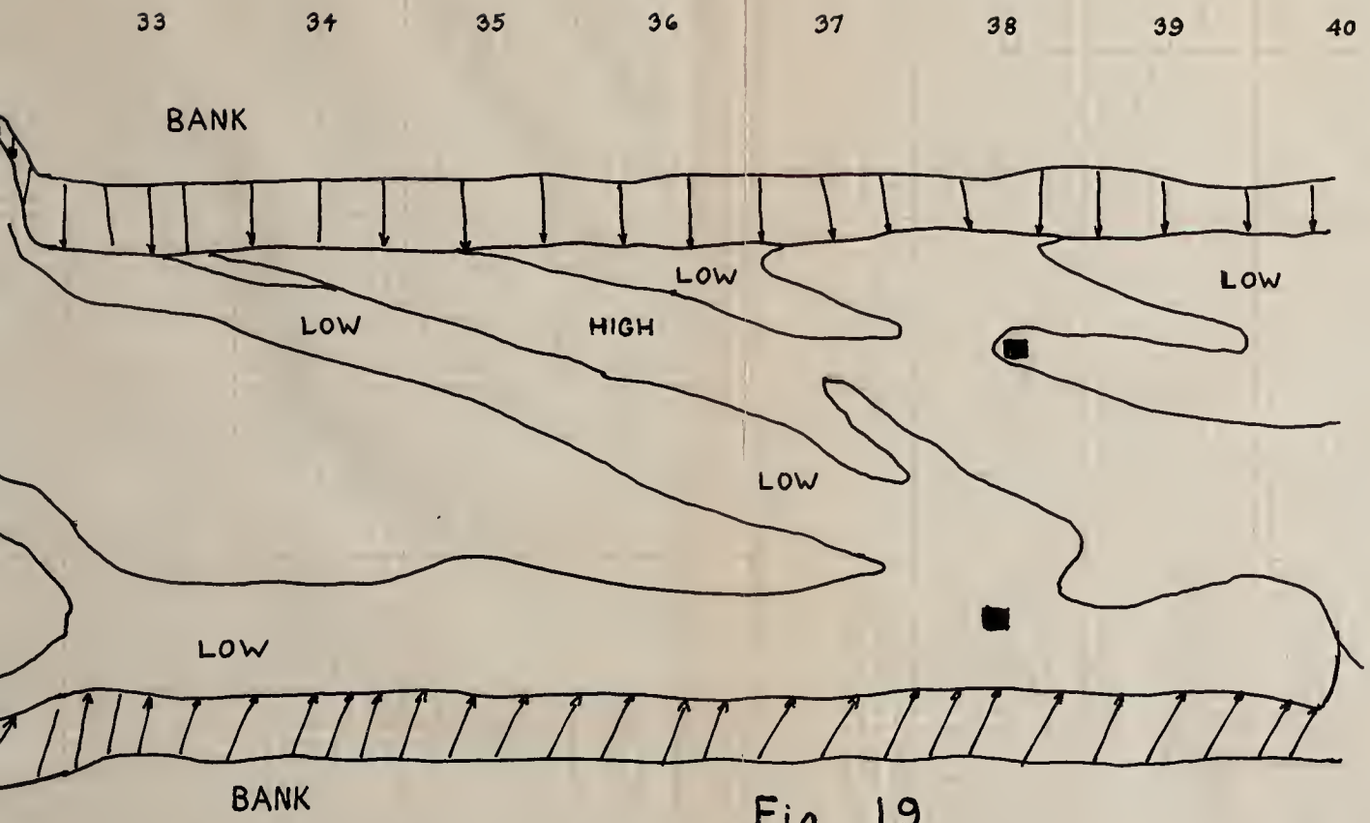


Fig. 19

TAYLOR FLATS MODEL
SKETCH MADE AT
CONCLUSION OF STUDY
JUST AFTER FLOW OF
0.45 CFS.

↓↓↓↓ Steep slope

FIG. 20 TRAY INLET

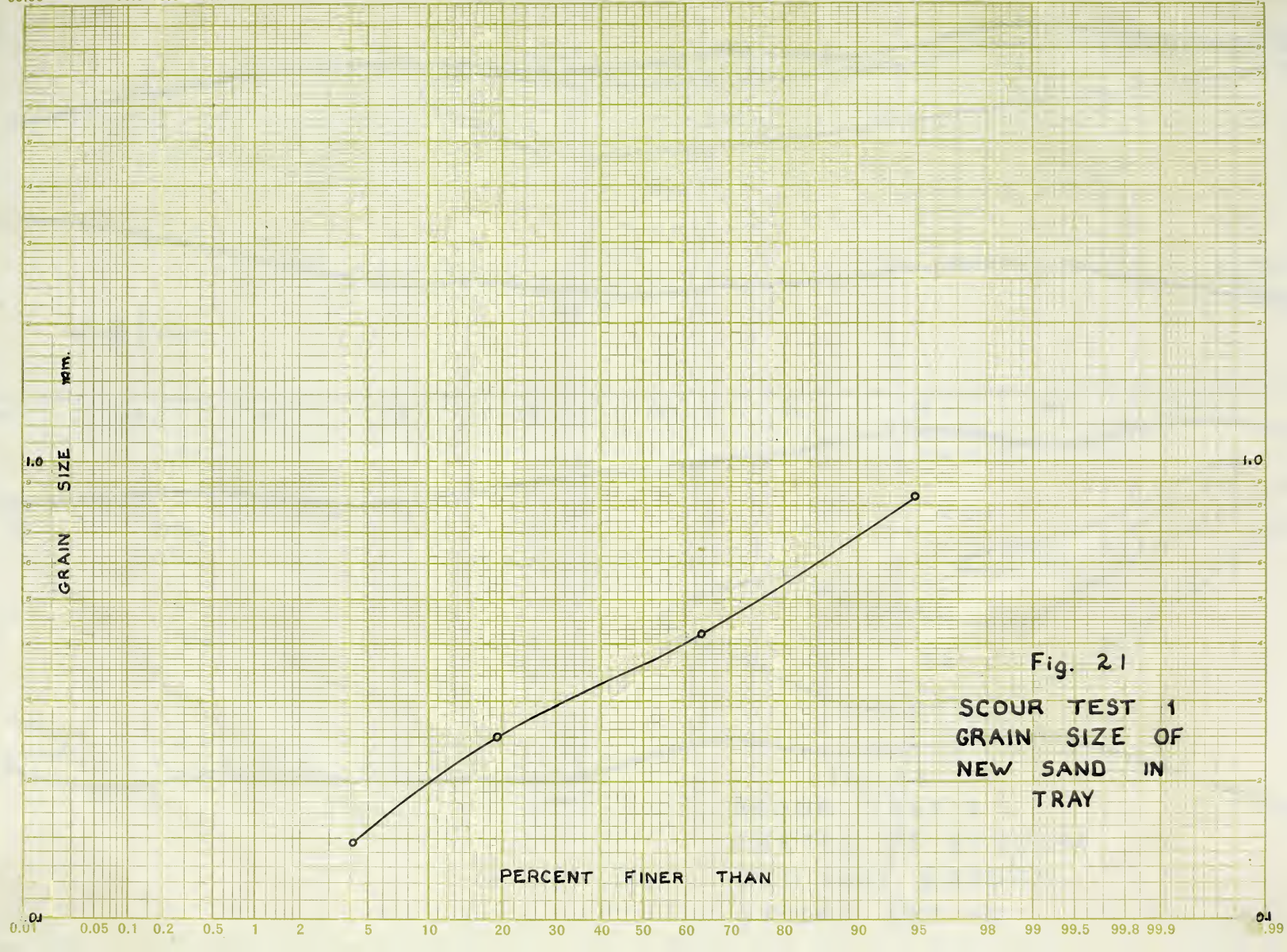


Fig. 21

SCOUR TEST 1
GRAIN SIZE OF
NEW SAND IN
TRAY

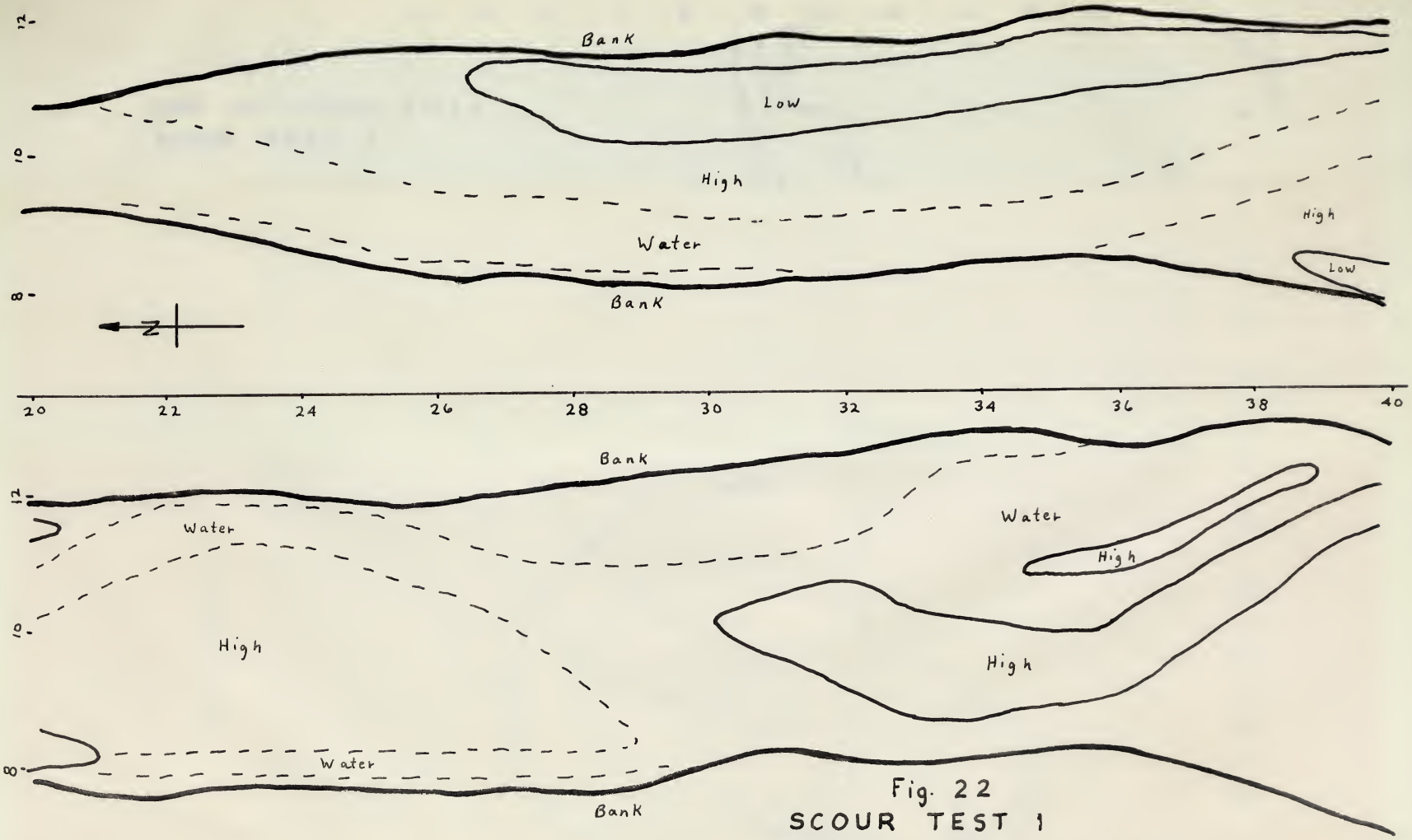


Fig. 22
SCOUR TEST 1
SKETCH OF STREAM
BED JUST BEFORE
SPURS SET IN

Fig. 23

MAP OF MODEL RIVER
SCOUR TEST 1

Spur
Burlap sacking
Edge of water
(Where there is no sacking)
A – P Site of sand samples
¼ – 8" Height above water surface

The spurs are numbered according to the steepness of their side slopes with number 1 having the steepest slope.

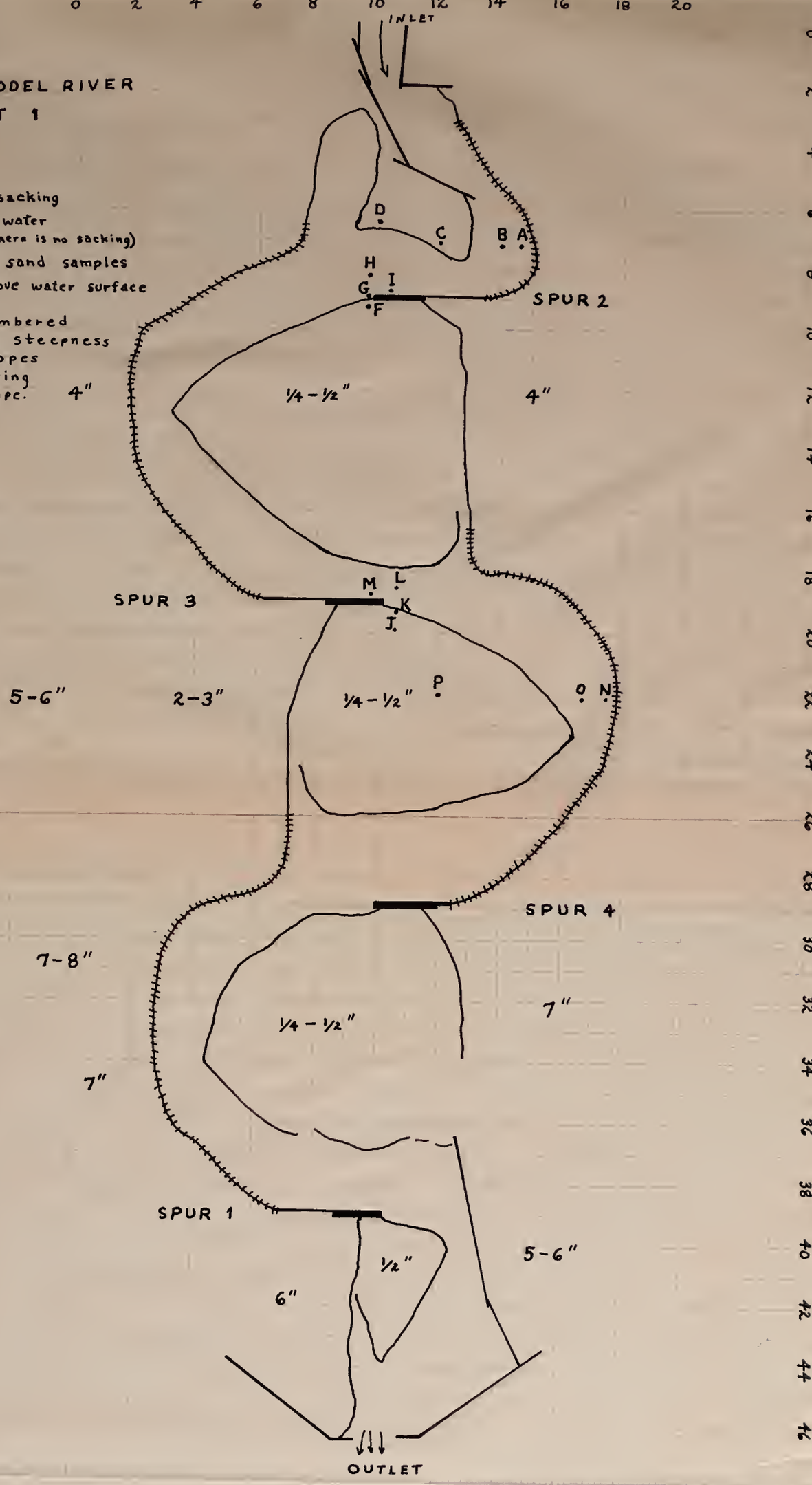


FIG. 24 SPUR POSITIONS FOR SCOUR TESTS 1 AND 2

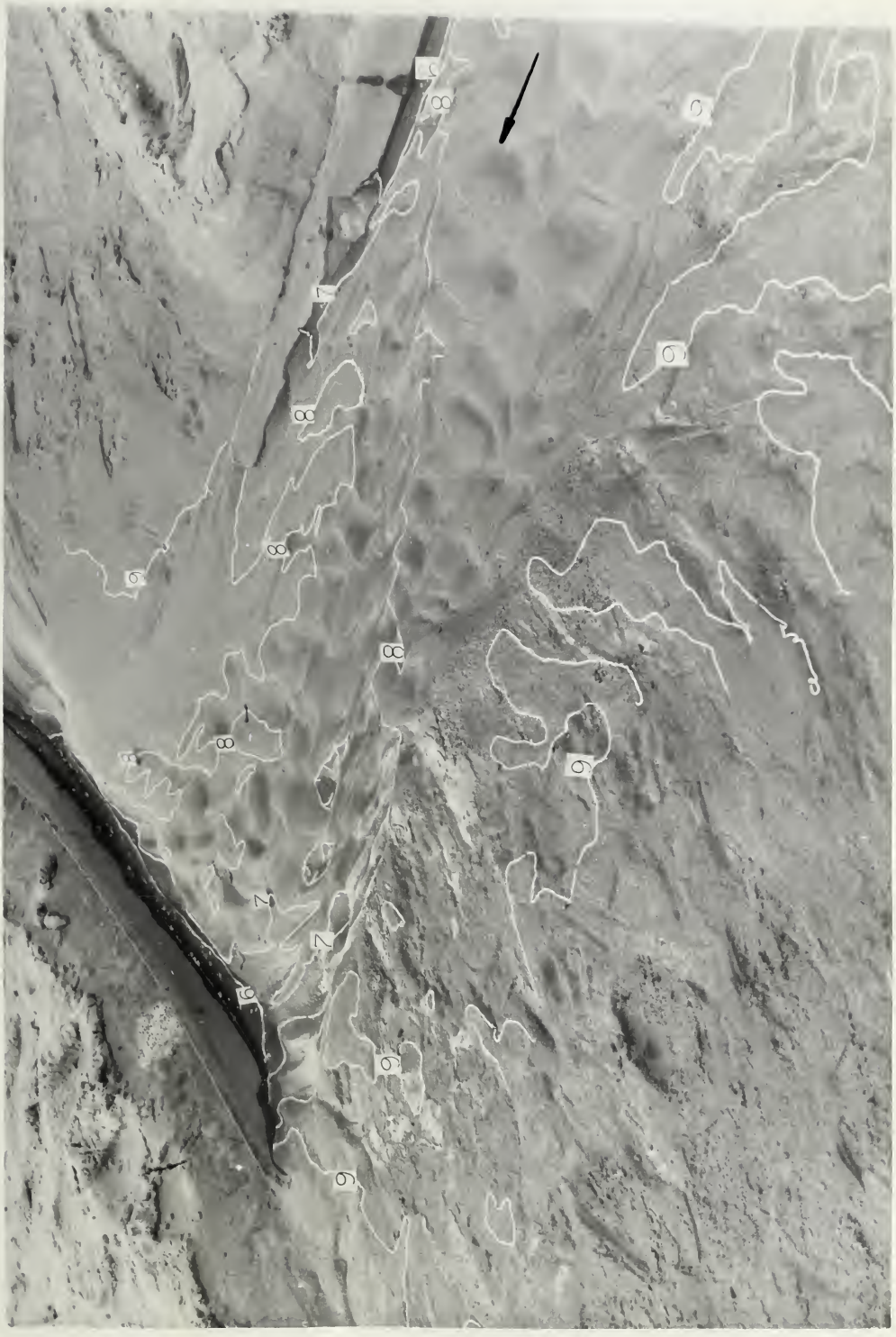


FIG. 25 SCOUR TEST 1 SPUR 1

C.I. = 2 cm.

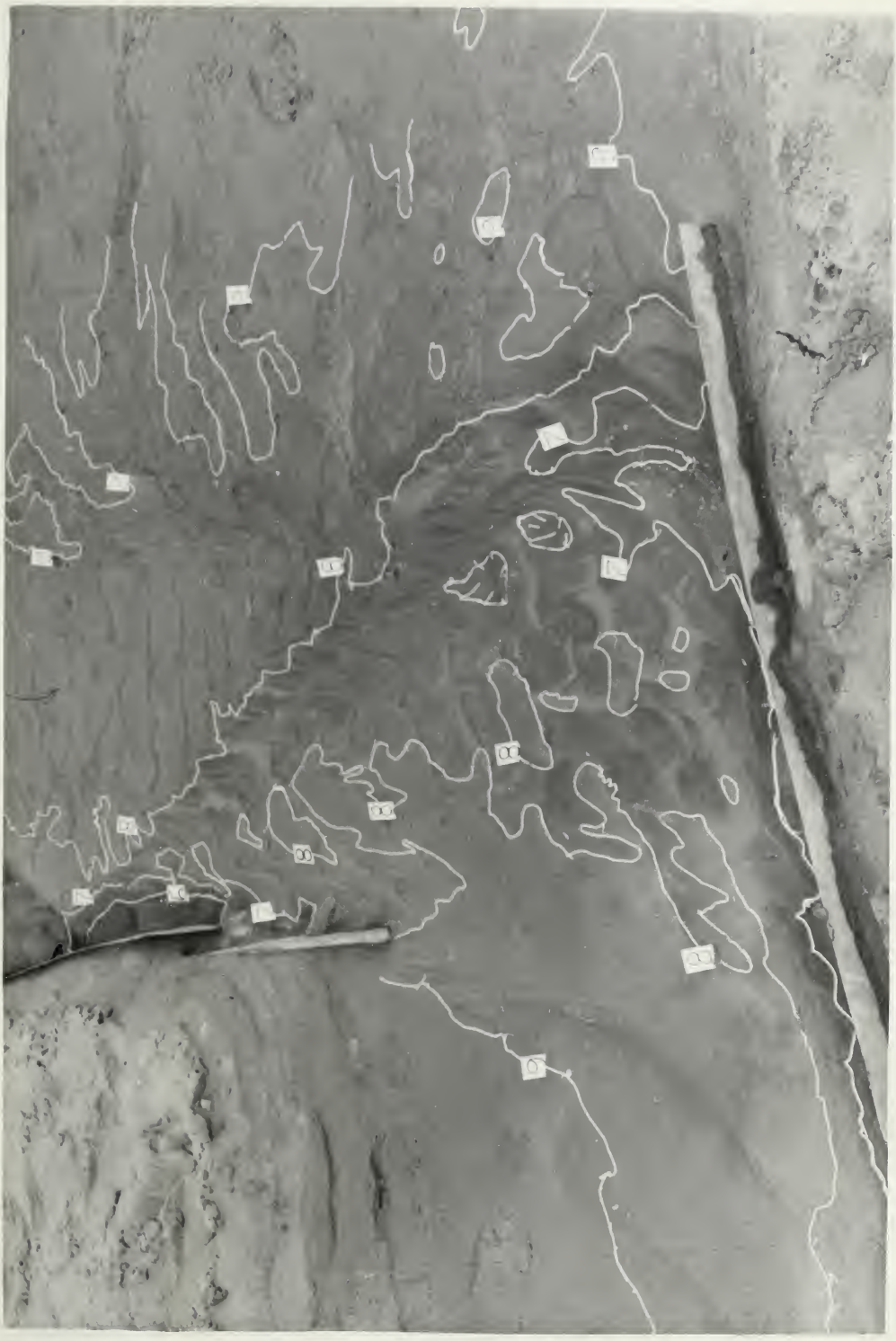


FIG. 26 SCOUR TEST 1 SPUR 1

C.I. = 2 cm.

FIG. 27 SCOUR TEST 1 SPUR 2

C.I. = 2 cm.

FIG. 28 SCOUR TEST 1 SPUR 2

C.I. = 2 cm.

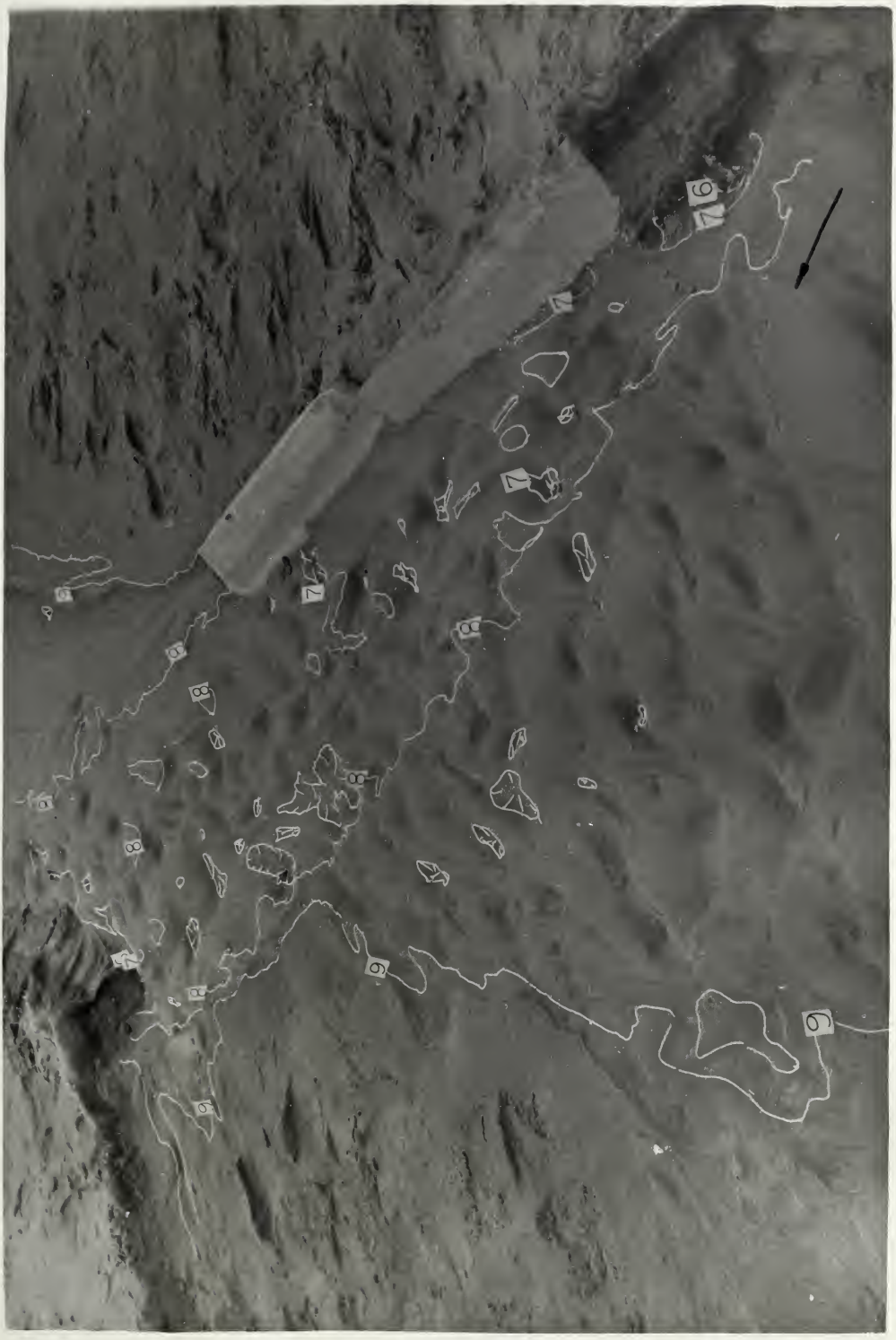


FIG. 29 SCOUR TEST 1 SPUR 3

C.I. = 2cm.

FIG. 30 SCOUR TEST 1 SPUR 3

C.I. = 2cm.

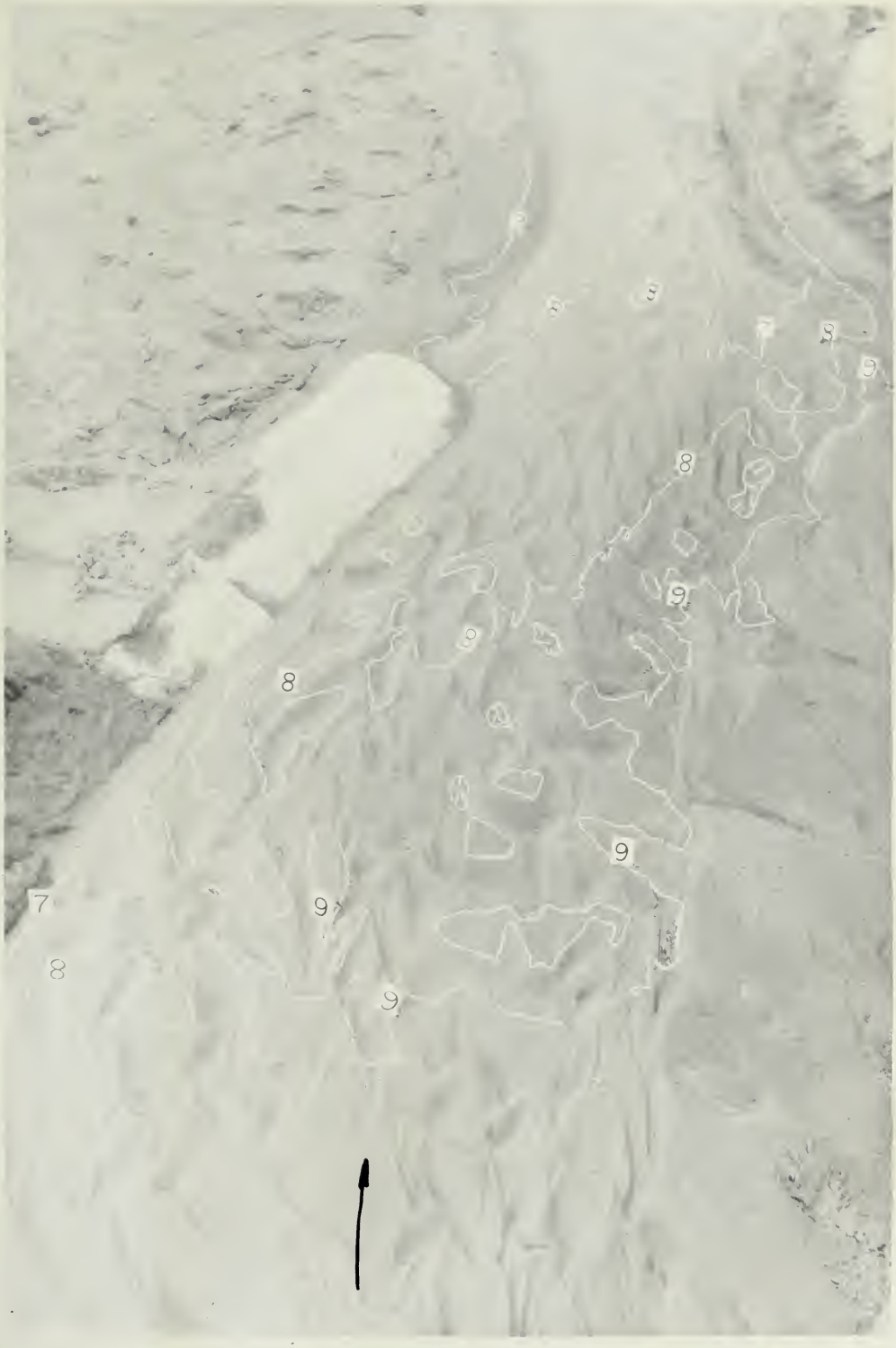
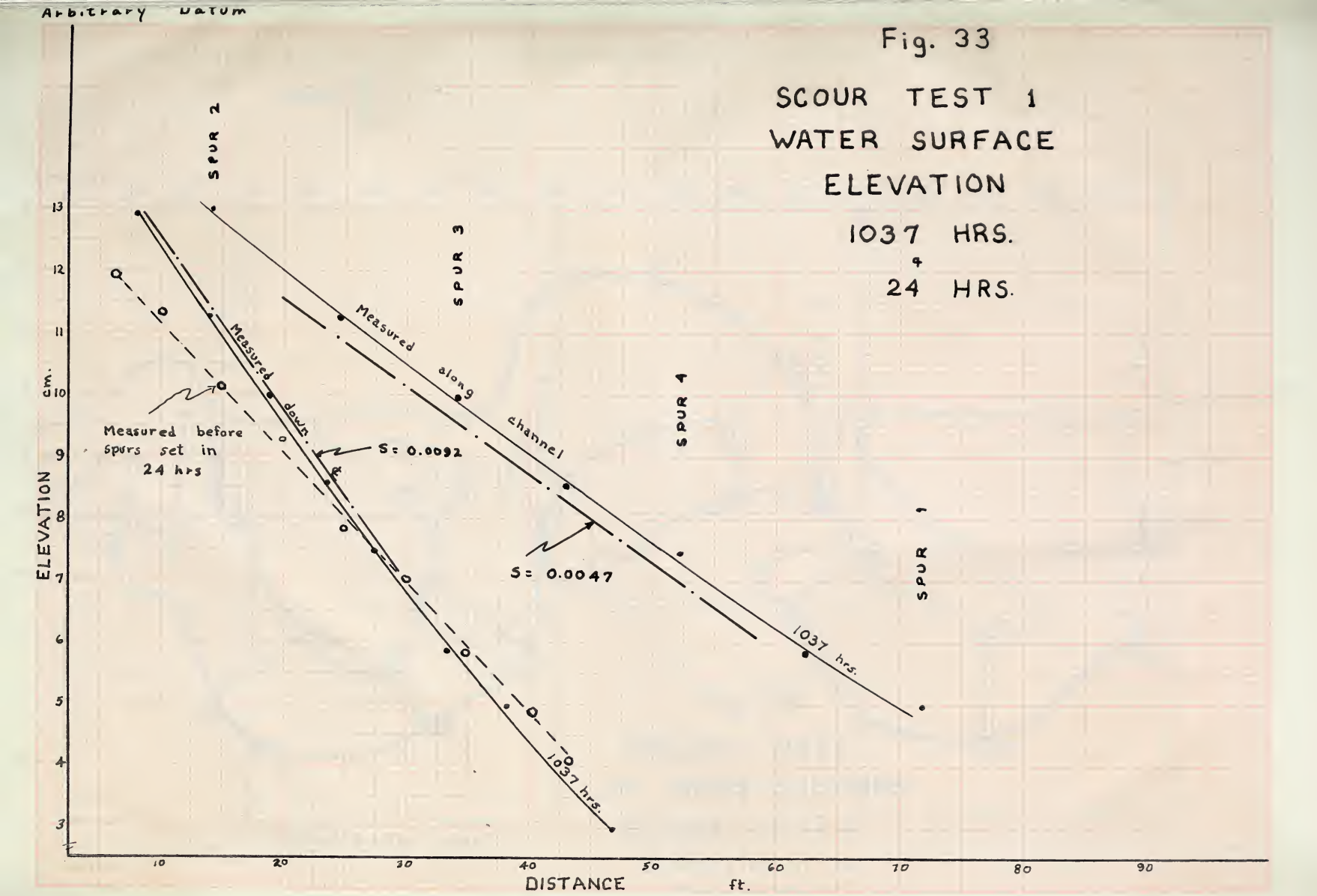


FIG. 31 SCOUR TEST 1 SPUR 4

C. I. = 2 cm.

FIG. 32 SCOUR TEST 1 SPUR 4

C. I. = 2cm.


Arbitrary Datum
Fig. 33
SCOUR TEST 1
WATER SURFACE
ELEVATION
1037 HRS.
&
24 HRS.
SPUR 2
SPUR 3
SPUR 4
SPUR 1
Measured along channel
Measured down
Measured before spurs set in 24 hrs
S = 0.0092
S = 0.0047
1037 hrs.
1037 hrs.
ELEVATION cm.
DISTANCE ft.
13
12
11
10
9
8
7
6
5
4
3
10
20
30
40
50
60
70
80
90

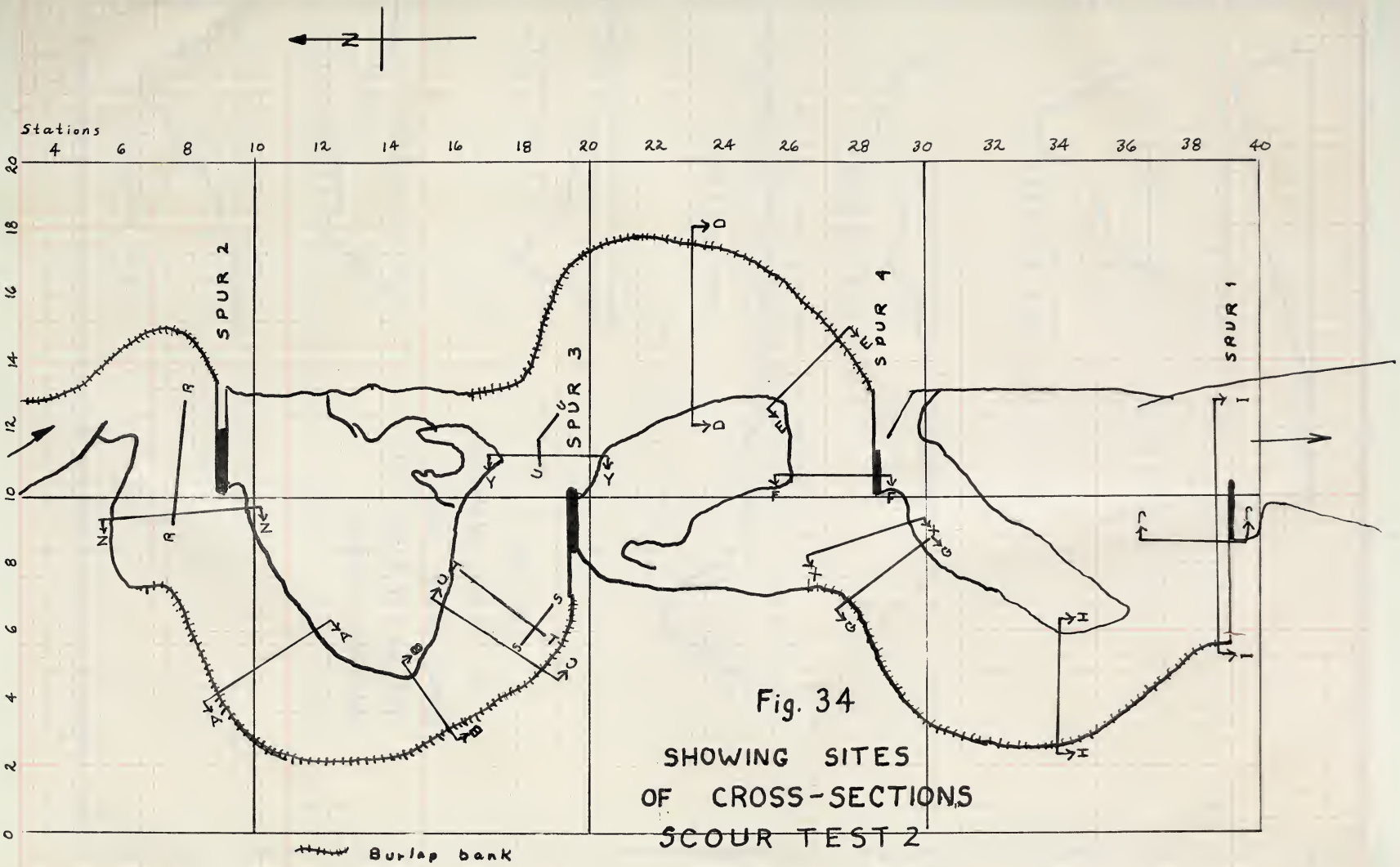


Fig. 34

SHOWING SITES
OF CROSS-SECTIONS
SCOUR TEST 2

Sections shown on
Figs. 35-38, 40

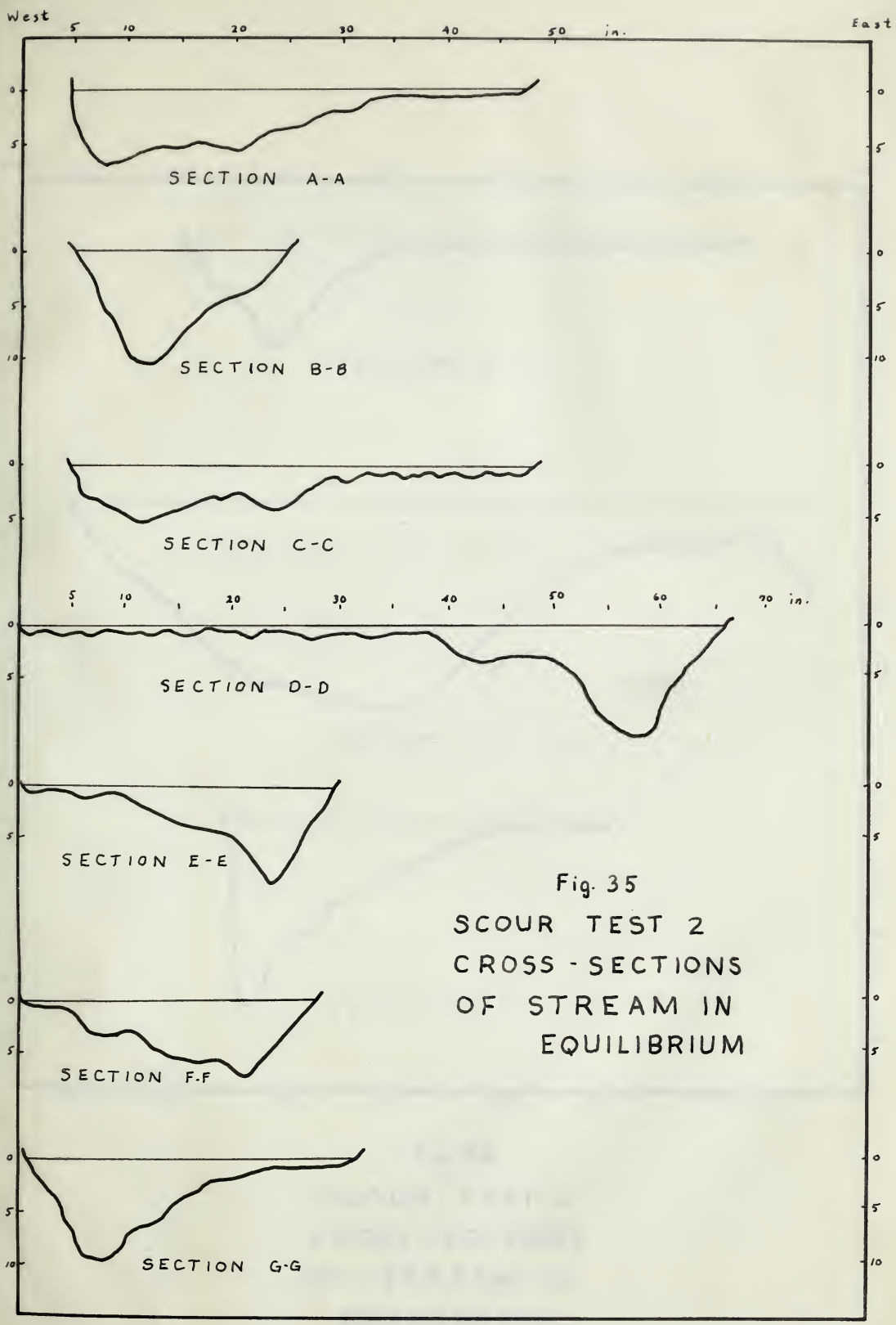


Fig. 35

SCOUR TEST 2
CROSS-SECTIONS
OF STREAM IN
EQUILIBRIUM

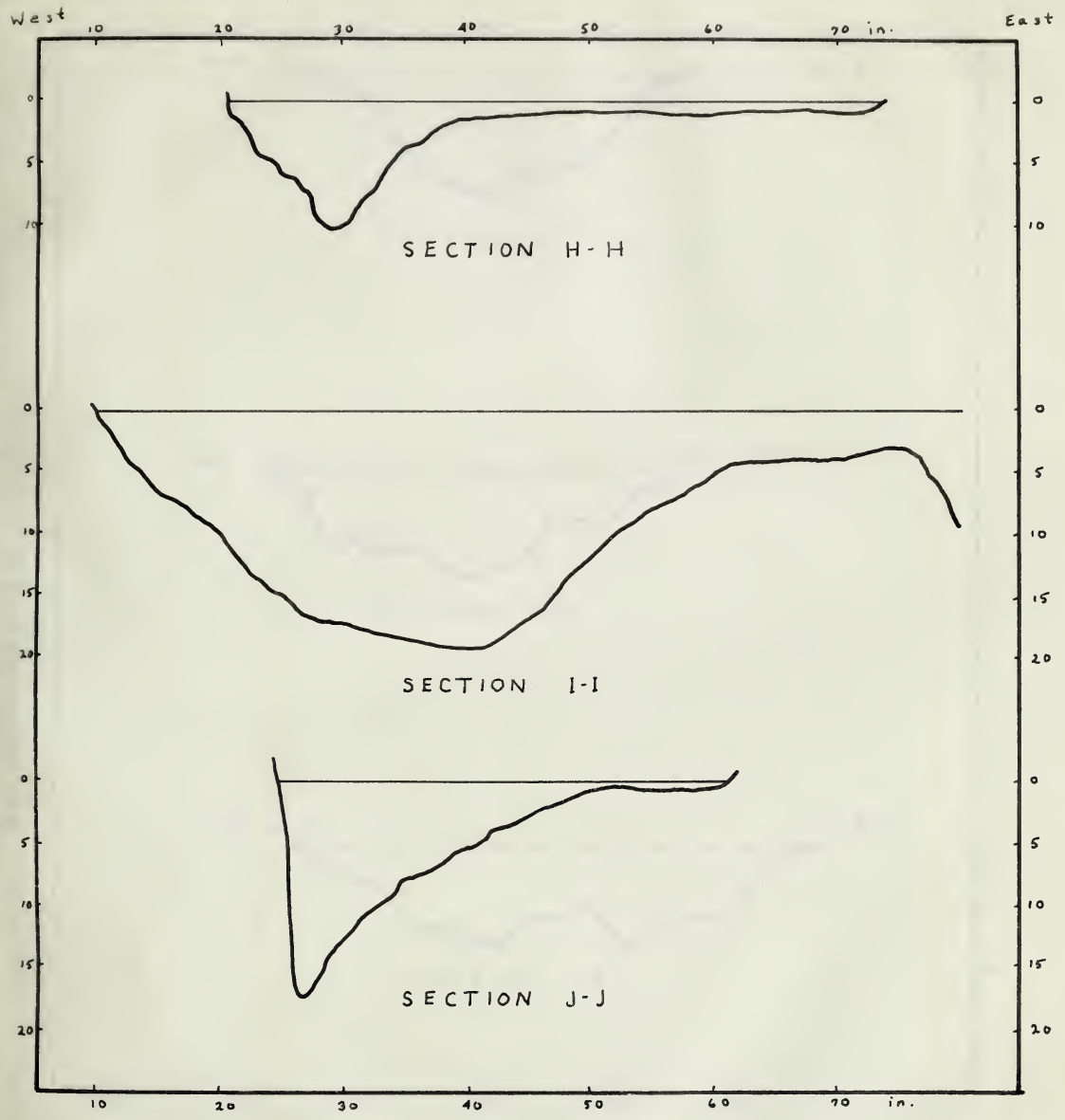


Fig. 36
SCOUR TEST 2
CROSS-SECTIONS
OF STREAM IN
EQUILIBRIUM

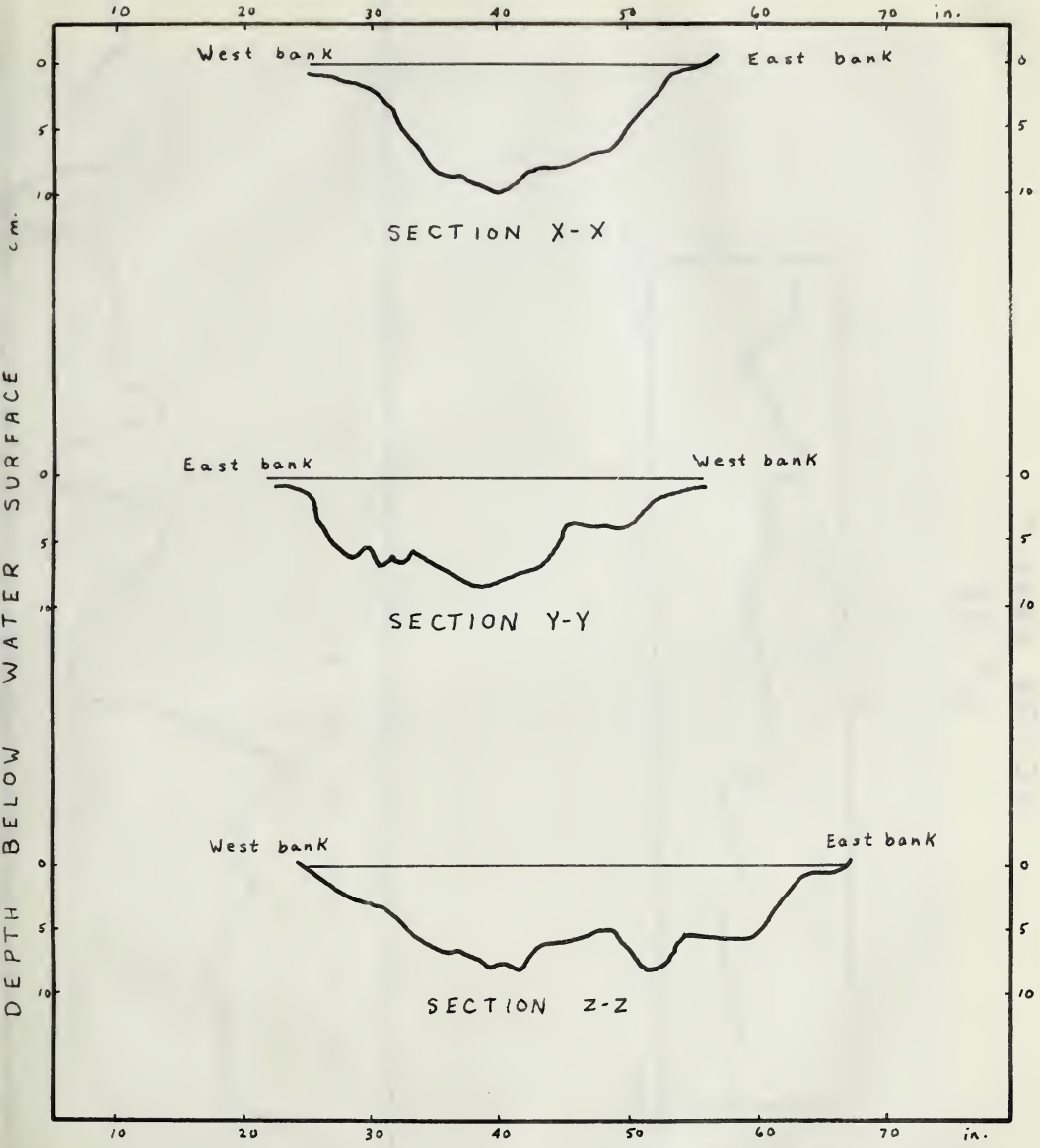
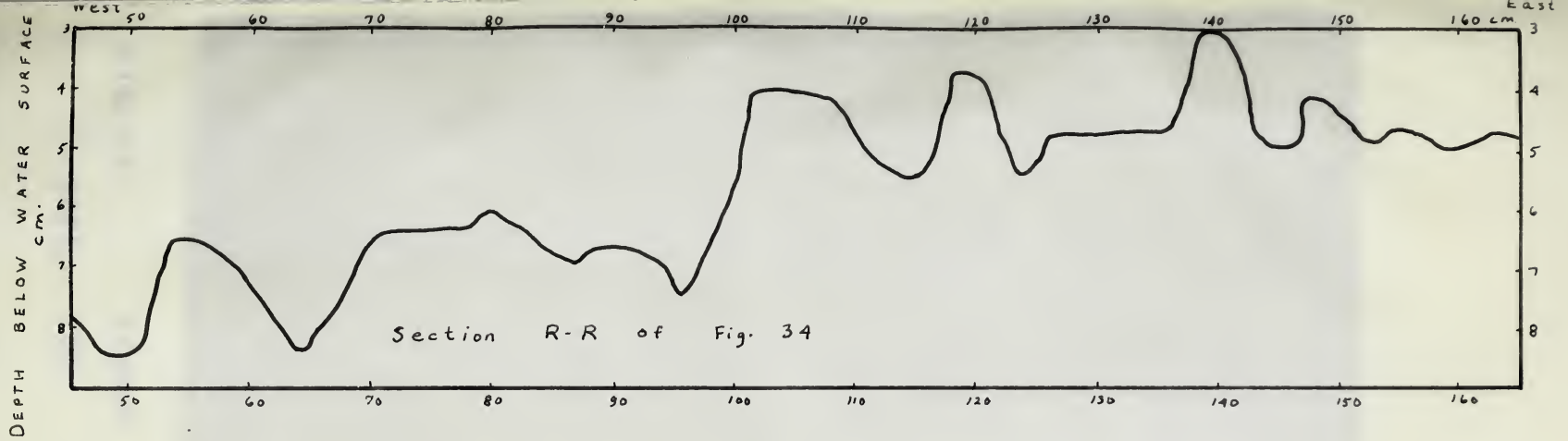


Fig. 37
SCOUR TEST 2
CROSS-SECTIONS
OF STREAM IN
EQUILIBRIUM



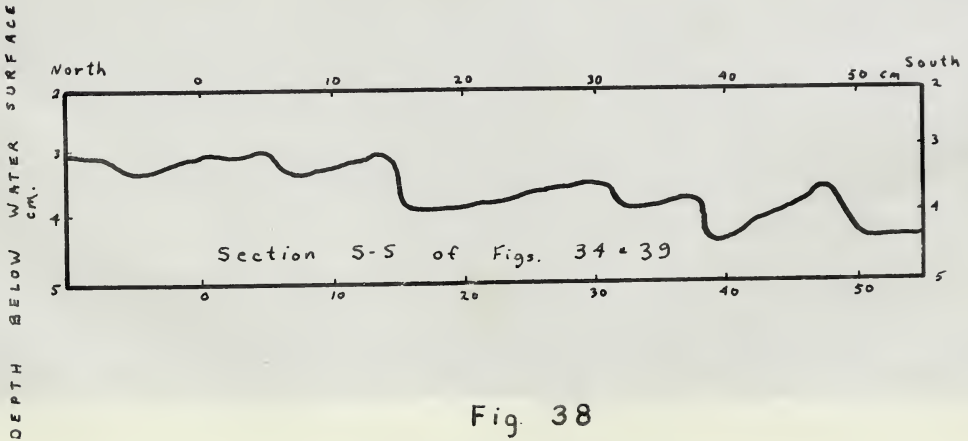


Fig. 38

SCOUR TEST 2

CROSS-SECTIONS

OF SAND DUNES

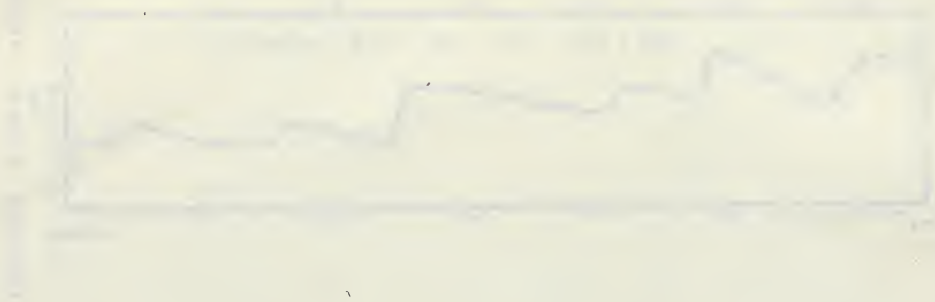


FIG. 39 SCOUR TEST 2
SITE OF CROSS-SECTIONS

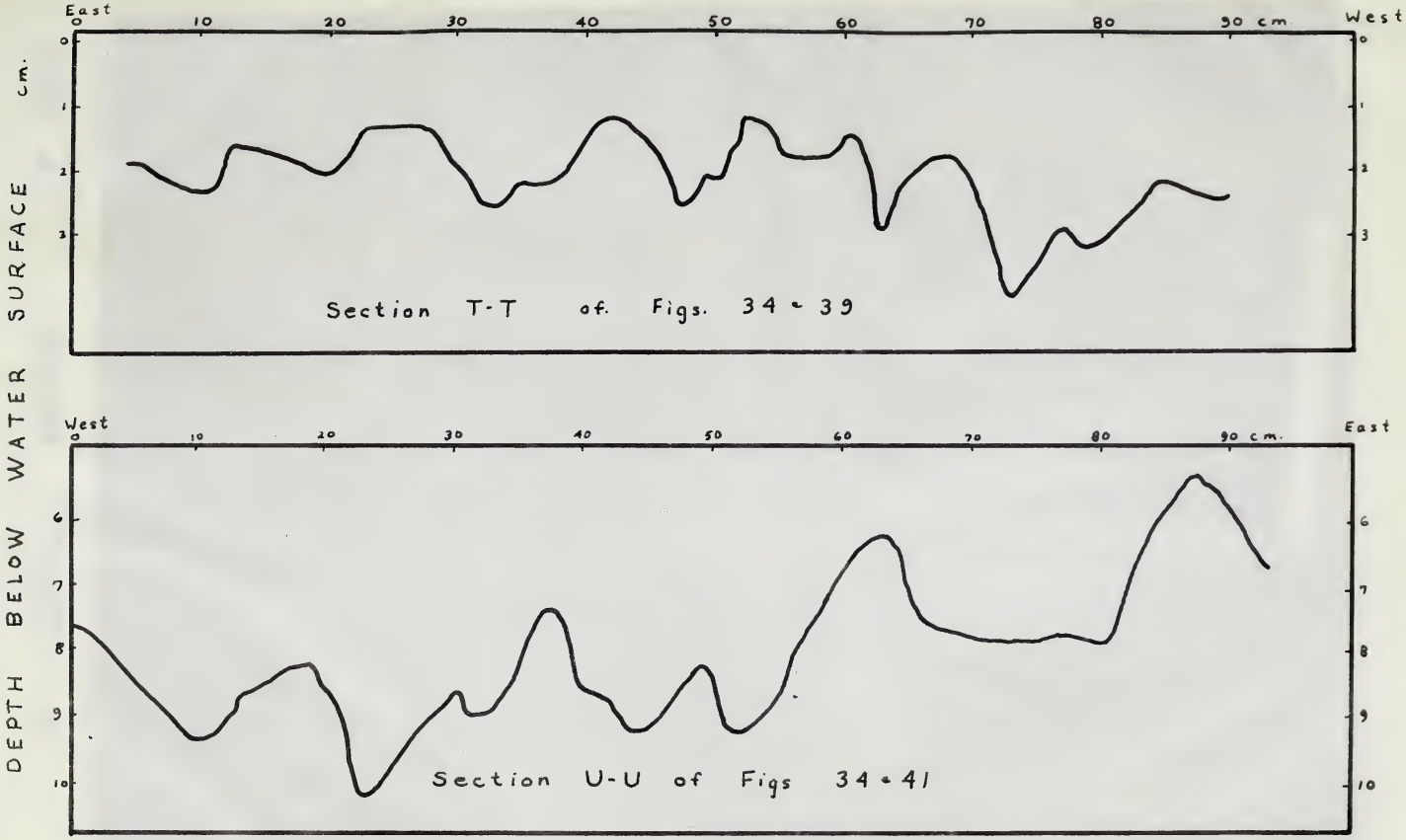


Fig. 40

SCOUR TEST 2

CROSS-SECTIONS

OF SAND DUNES

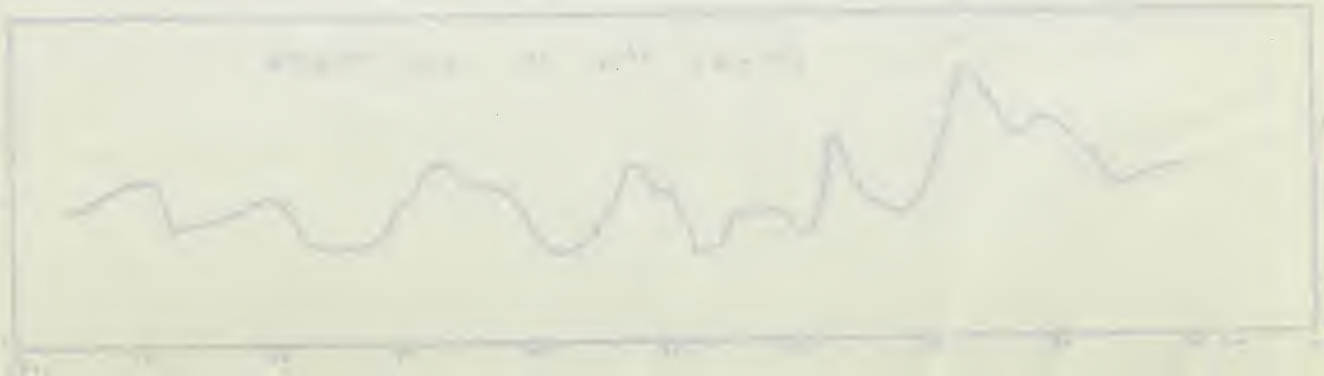


FIG. 41 SCOUR TEST 2

SITE OF CROSS-SECTIONS

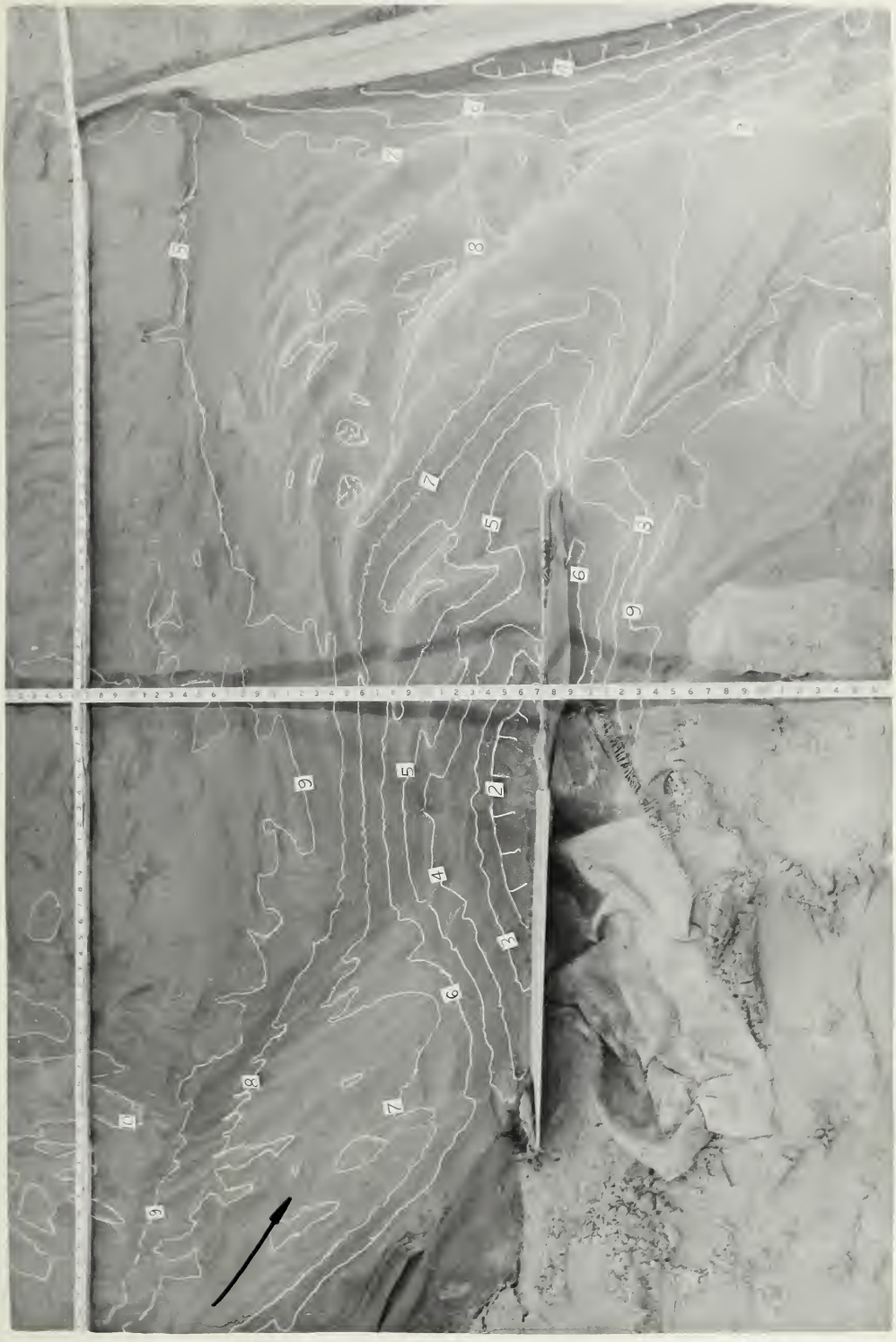


FIG. 42 SCOUR TEST 2 SPUR 1

C.I. = 2 cm.

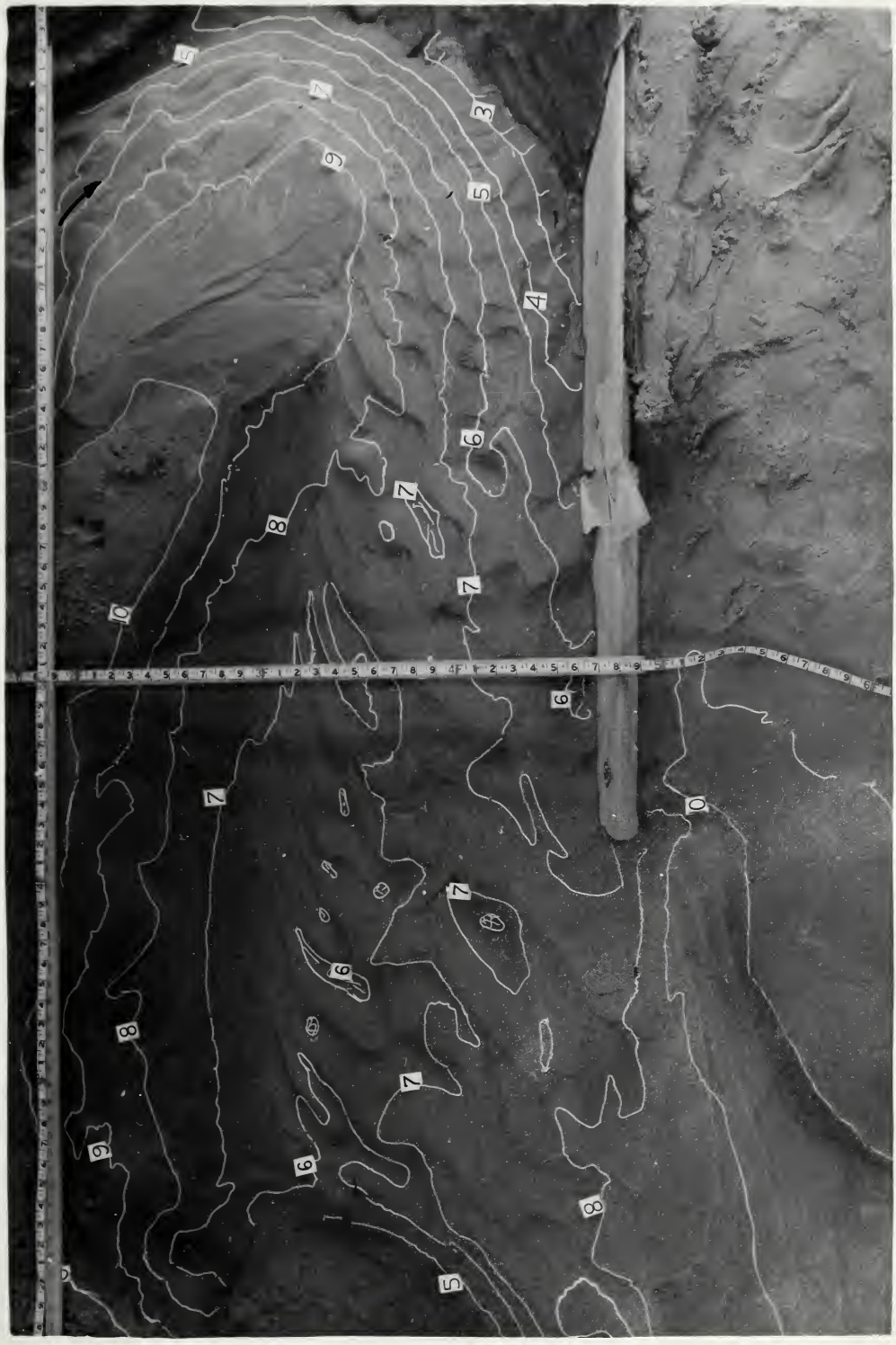


FIG. 43 SCOUR TEST 2 SPUR 2

C.I. = 2cm.

FIG. 44 SCOUR TEST 2 SPUR 3

C.I. = 2cm.

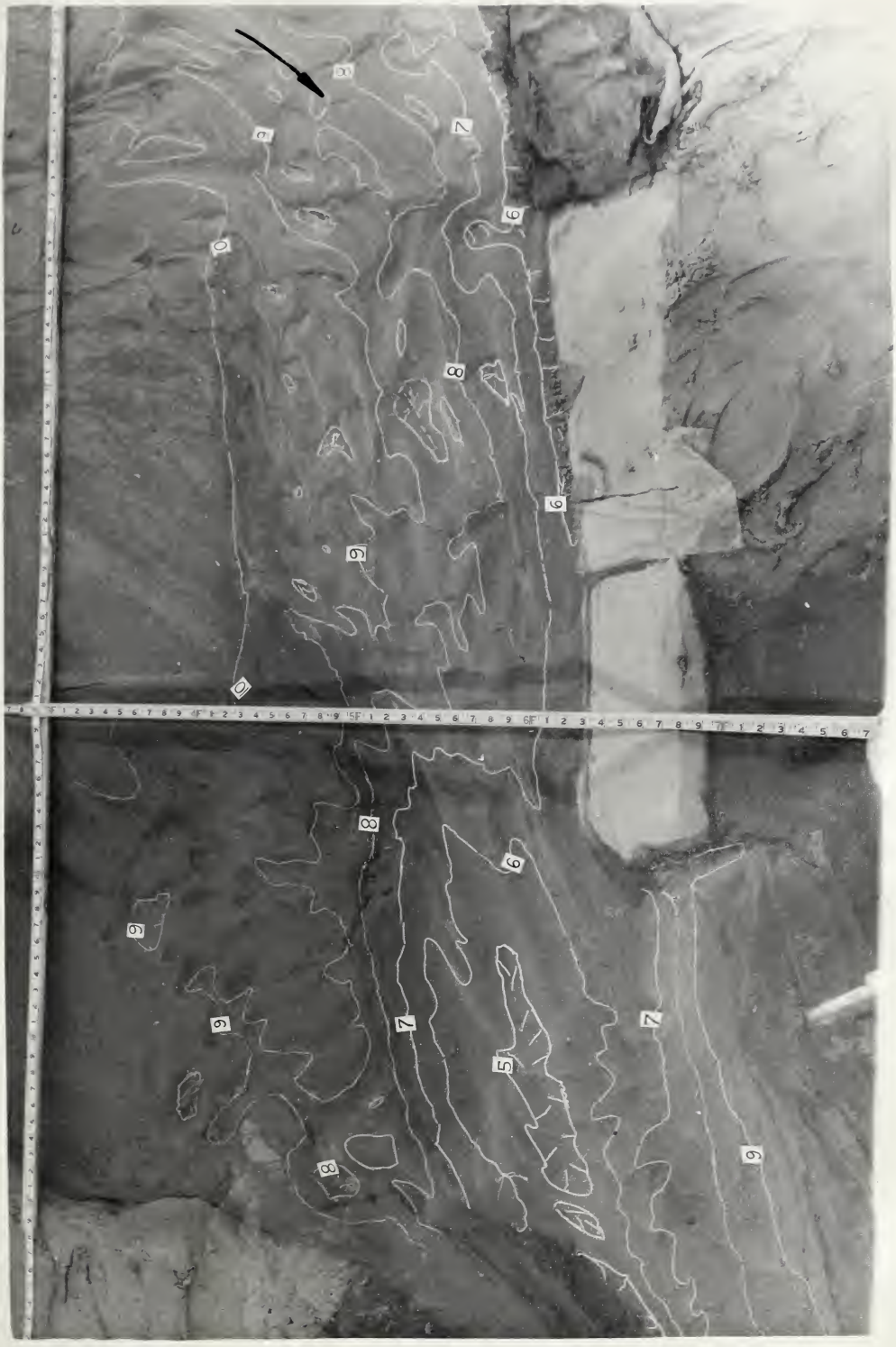
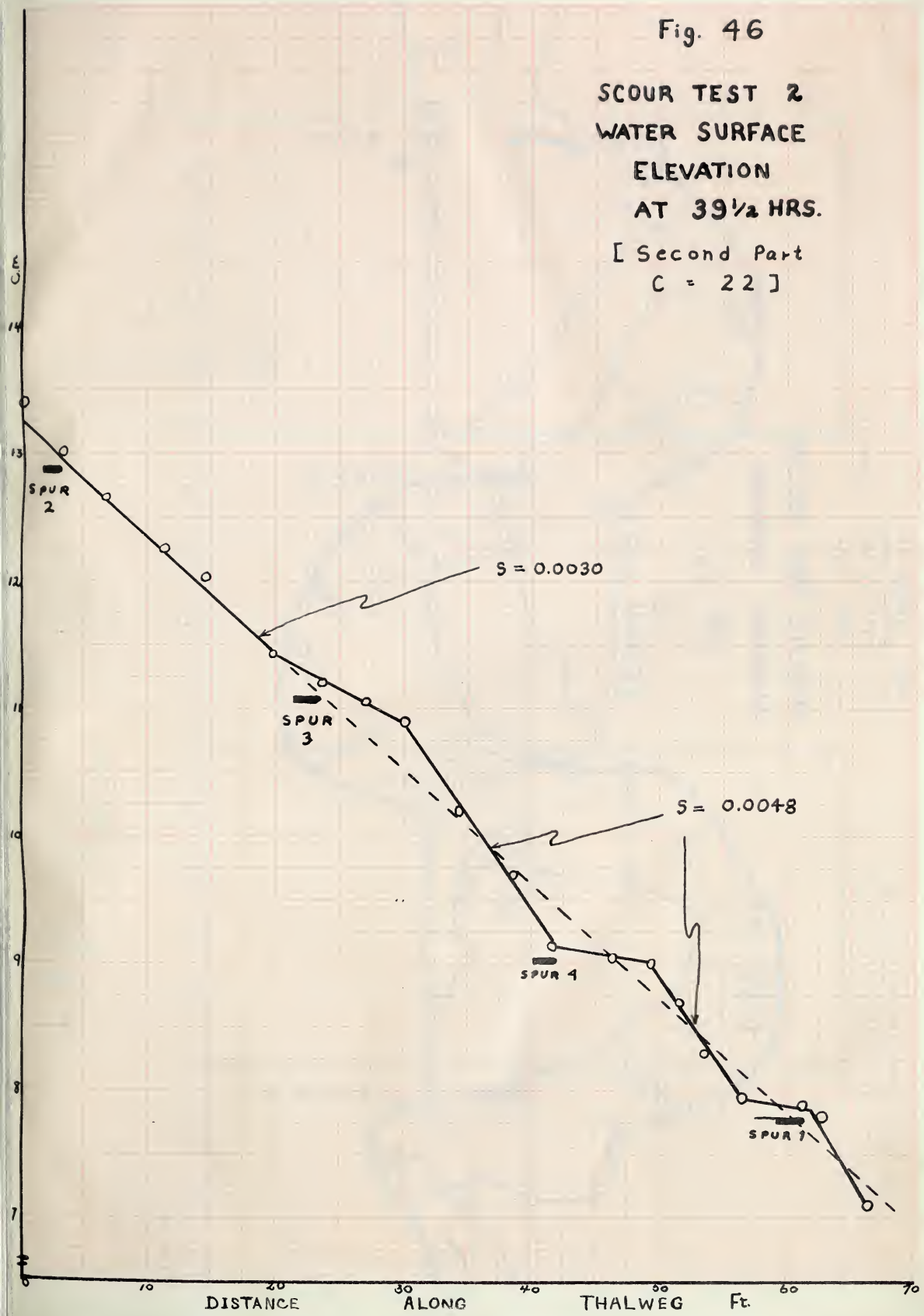


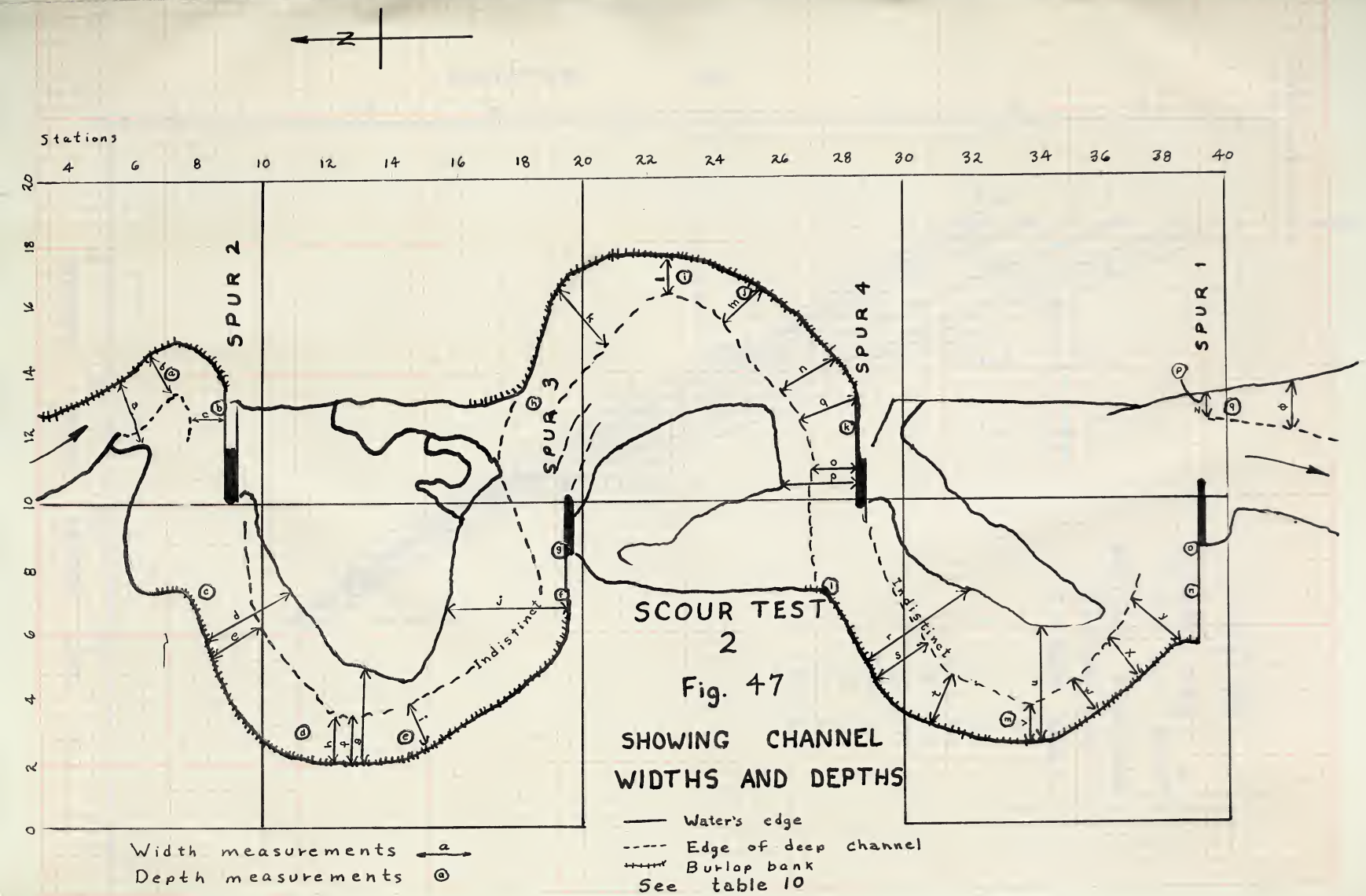
FIG. 45 SCOUR TEST 2 SPUR 4

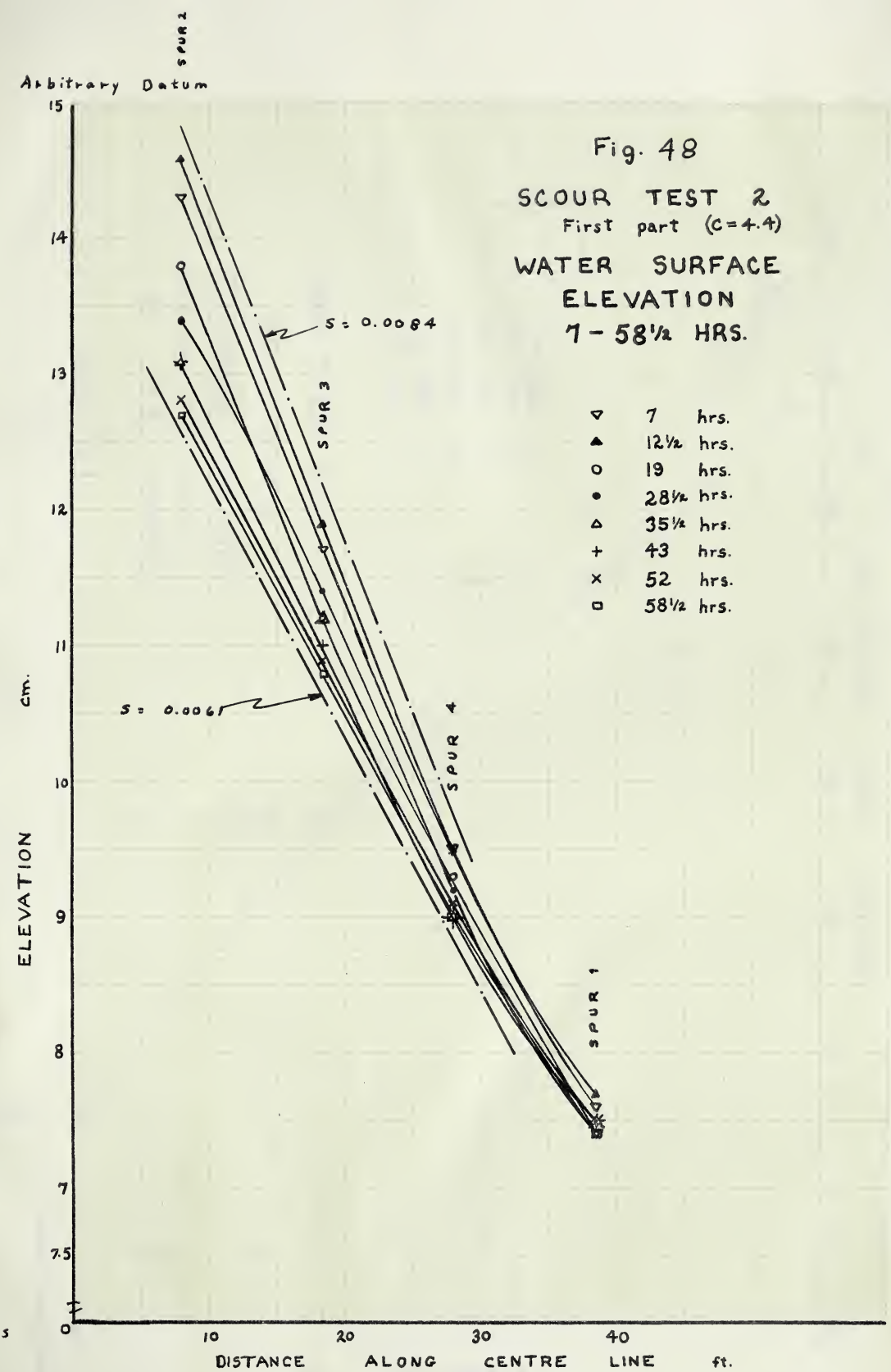
C.I. = 2 cm.

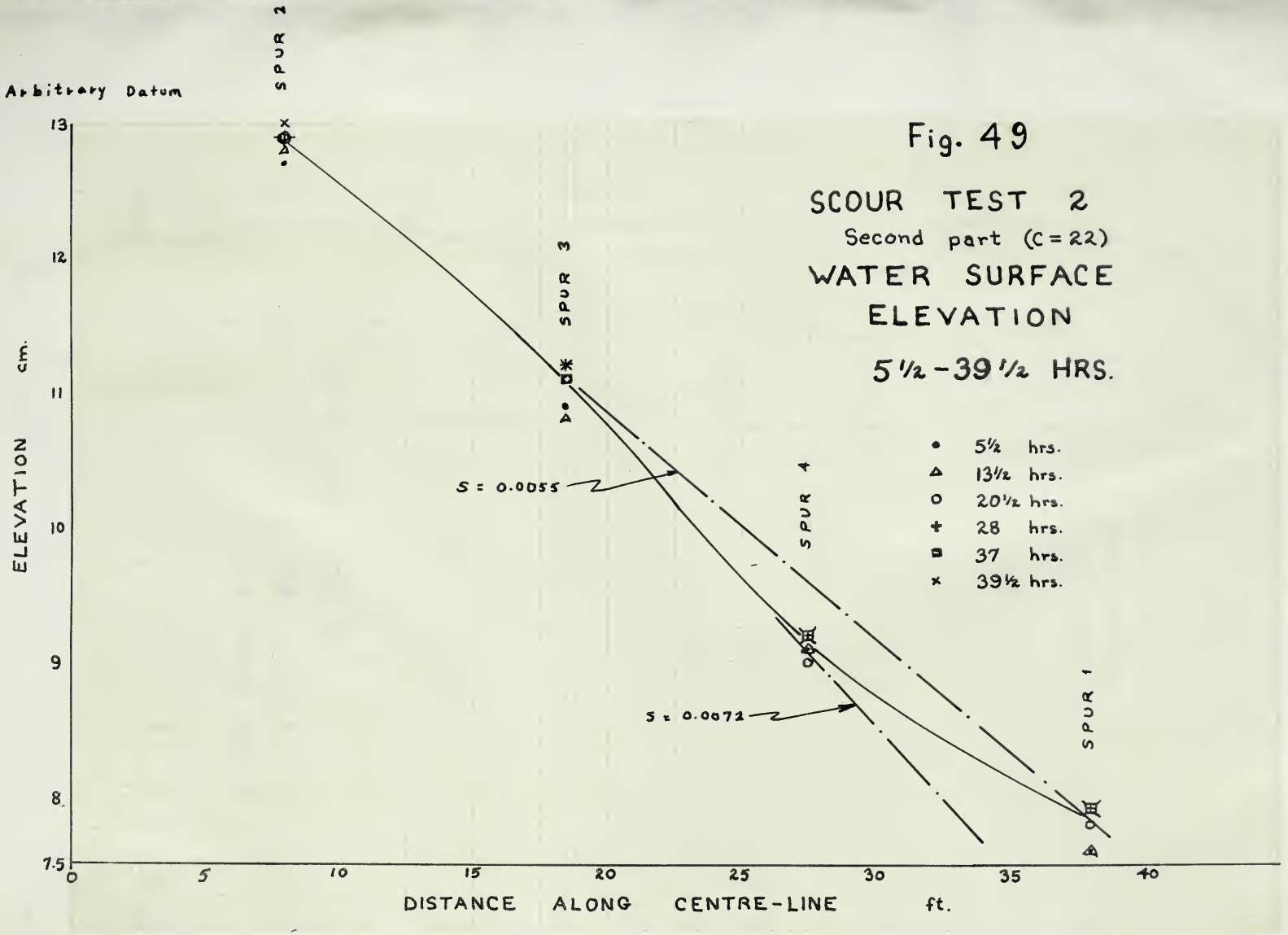
Fig. 46

SCOUR TEST 2
WATER SURFACE
ELEVATION
AT 39½ HRS.
[Second Part
C = 22]




N
Stations
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
0 2 4 6 8 10 12 14 16 18 20
SPUR 2
SPUR 3
SPUR 4
SPUR 1
Indistinct
Indistinct
SCOUR TEST 2
Fig. 47
SHOWING CHANNEL WIDTHS AND DEPTHS
Width measurements a
Depth measurements ⓐ
Water's edge
Edge of deep channel
Burlap bank
See table 10


Arbitrary Datum
SPUR 2
15
14
13
12
11
10
9
8
7
7.5
0
cm.
ELEVATION
S = 0.0084
S = 0.0061
SPUR 3
SPUR 4
SPUR 1
10
20
30
40
DISTANCE ALONG CENTRE LINE ft.
Fig. 48
SCOUR TEST 2
First part (C = 4.4)
WATER SURFACE ELEVATION
7 - 58½ HRS.
7 hrs.
12½ hrs.
19 hrs.
28½ hrs.
35½ hrs.
43 hrs.
52 hrs.
58½ hrs.


Arbitrary Datum
SPUR 2
SPUR 3
SPUR 4
SPUR 1
ELEVATION cm.
13
12
11
10
9
8
7.5
0
5
10
15
20
25
30
35
40
DISTANCE ALONG CENTRE-LINE ft.
S = 0.0055
S = 0.0072
5½ hrs.
13½ hrs.
20½ hrs.
28 hrs.
37 hrs.
39½ hrs.
Fig. 49
SCOUR TEST 2
Second part (C = 22)
WATER SURFACE ELEVATION
5½ - 39½ HRS.

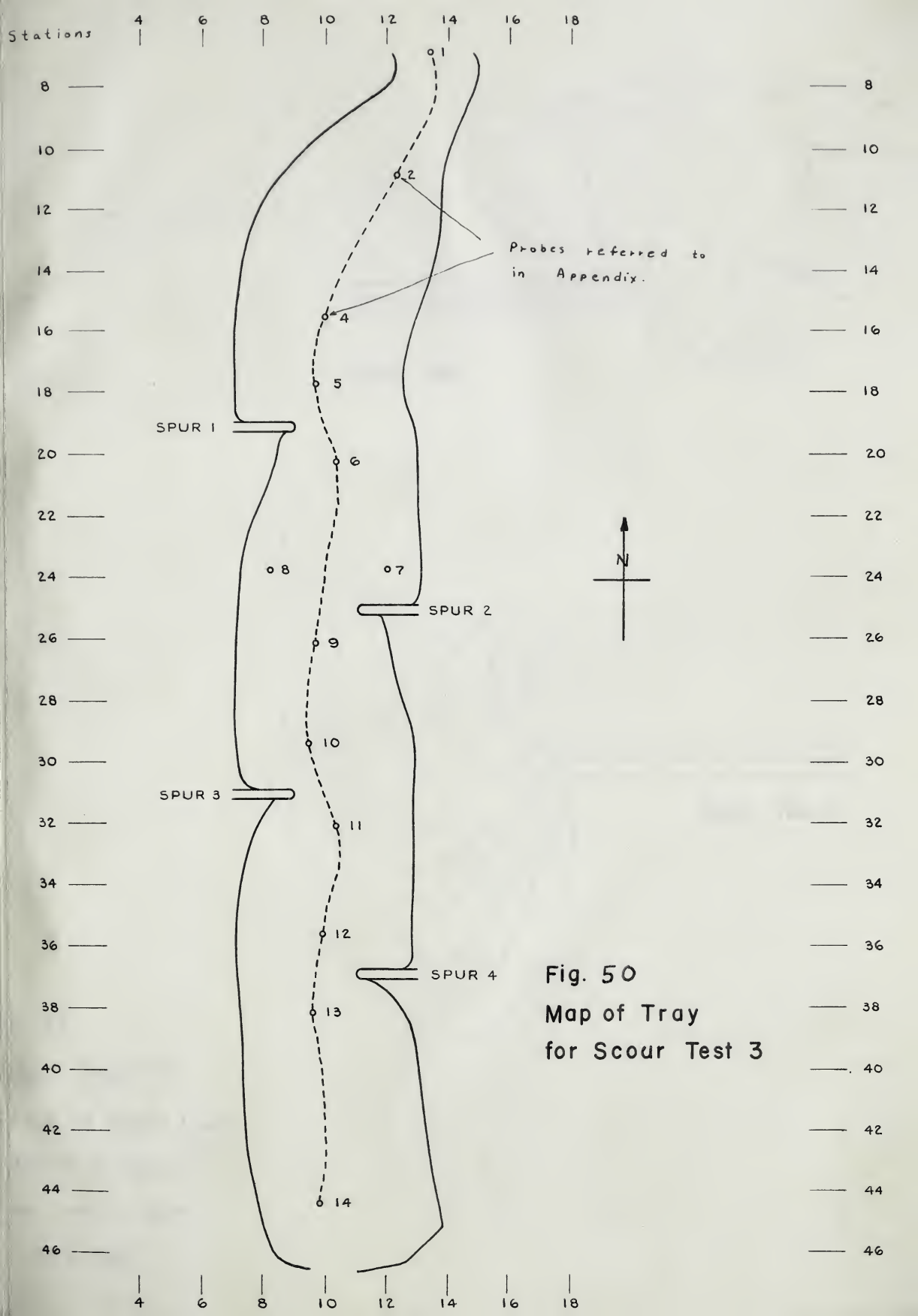
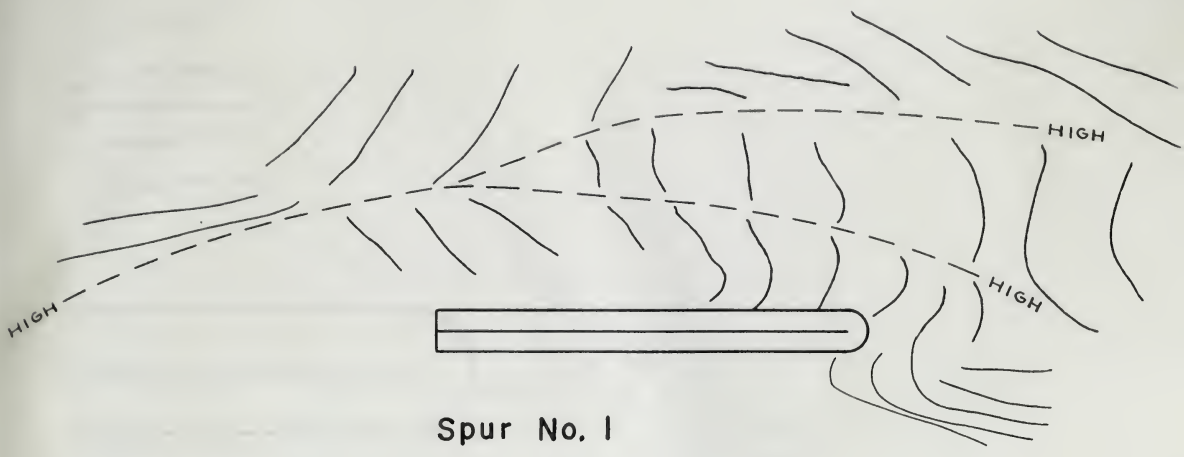
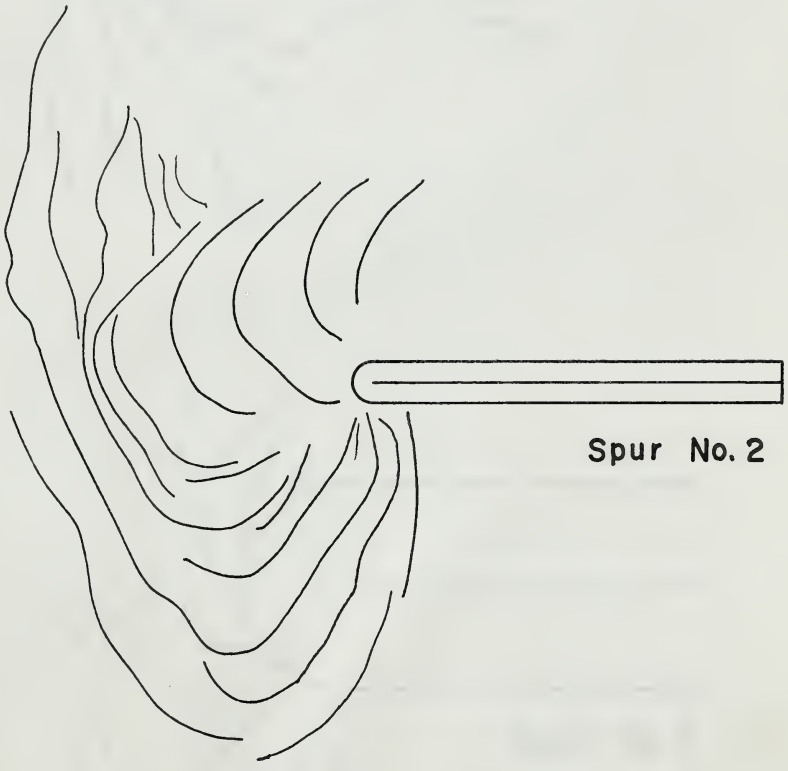


Fig. 50
Map of Tray
for Scour Test 3



Spur No. 1



Spur No. 2

g. 51

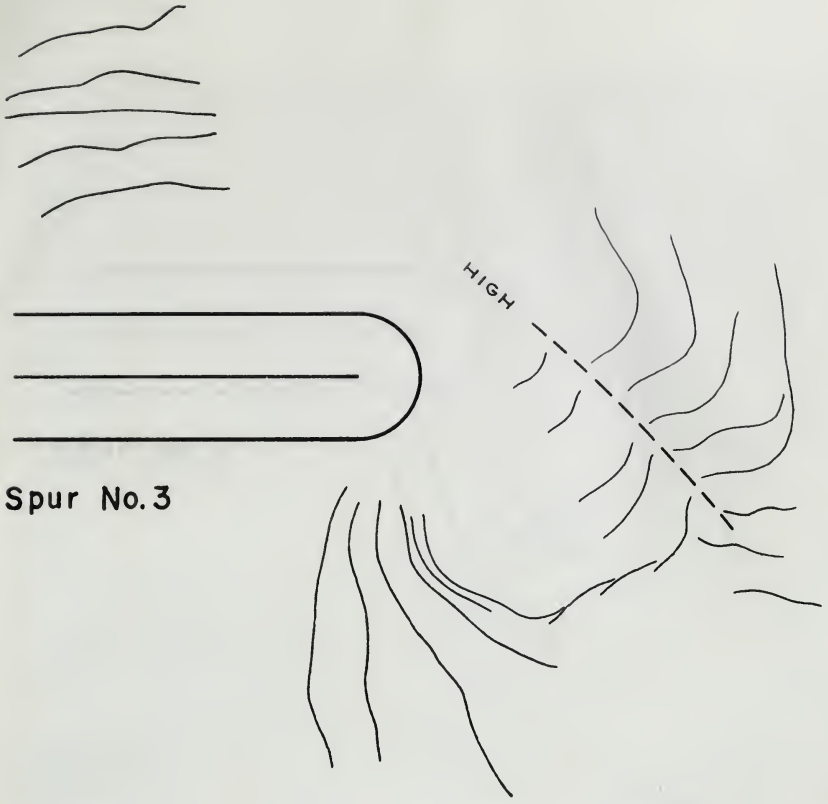
cour Test 3

ketch of Sand Dune

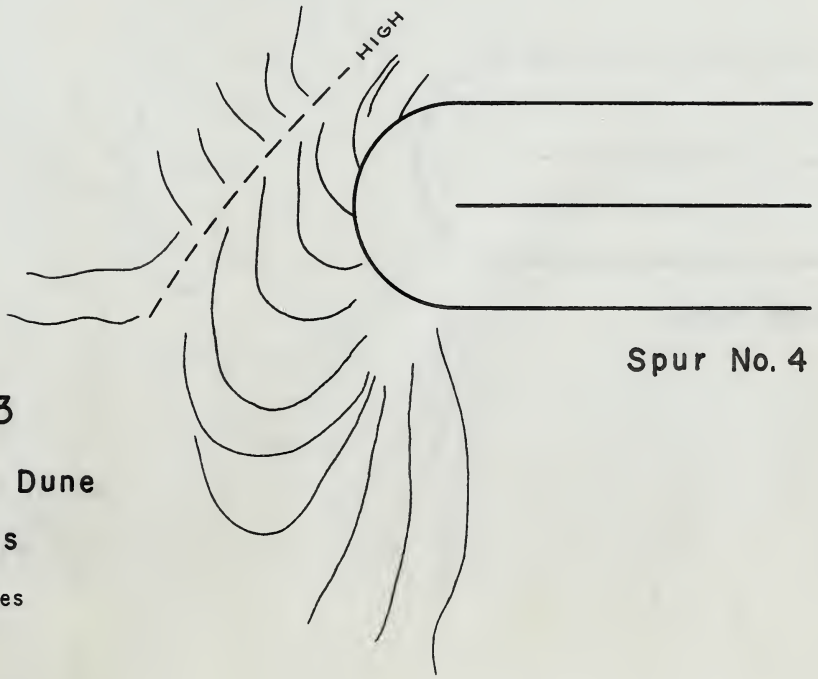
ittern at Spurs

ale: 1 inch = 8 inches

10.9 hrs.



Spur No. 3



Spur No. 4

g. 52

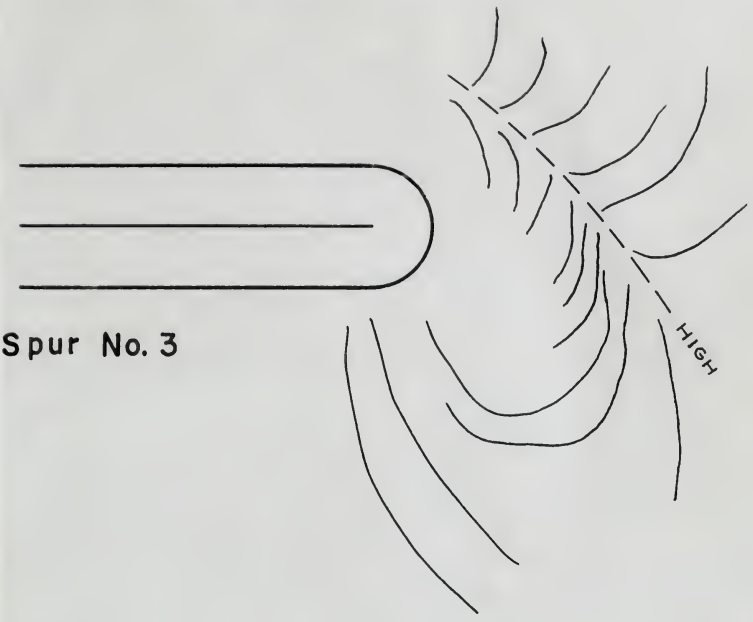
our Test 3

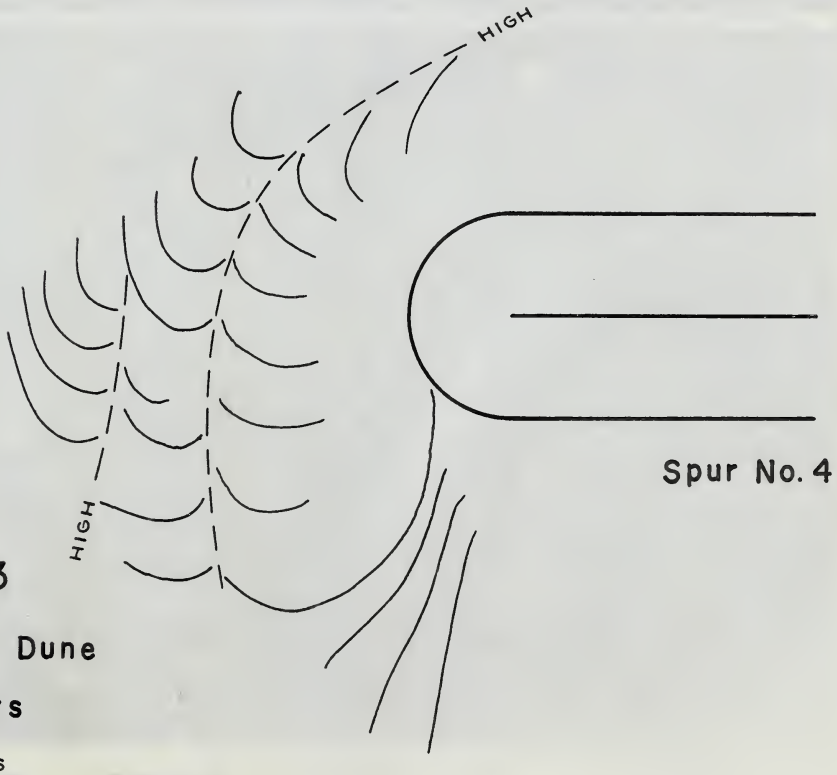
etch of Sand Dune

ttern at Spurs

le: 1 inch = 8 inches

10.9 hrs.





). 53

:our Test 3

etch of Sand Dune

ttern at Spurs

le: 1 inch = 8 inches

14.0 hrs.

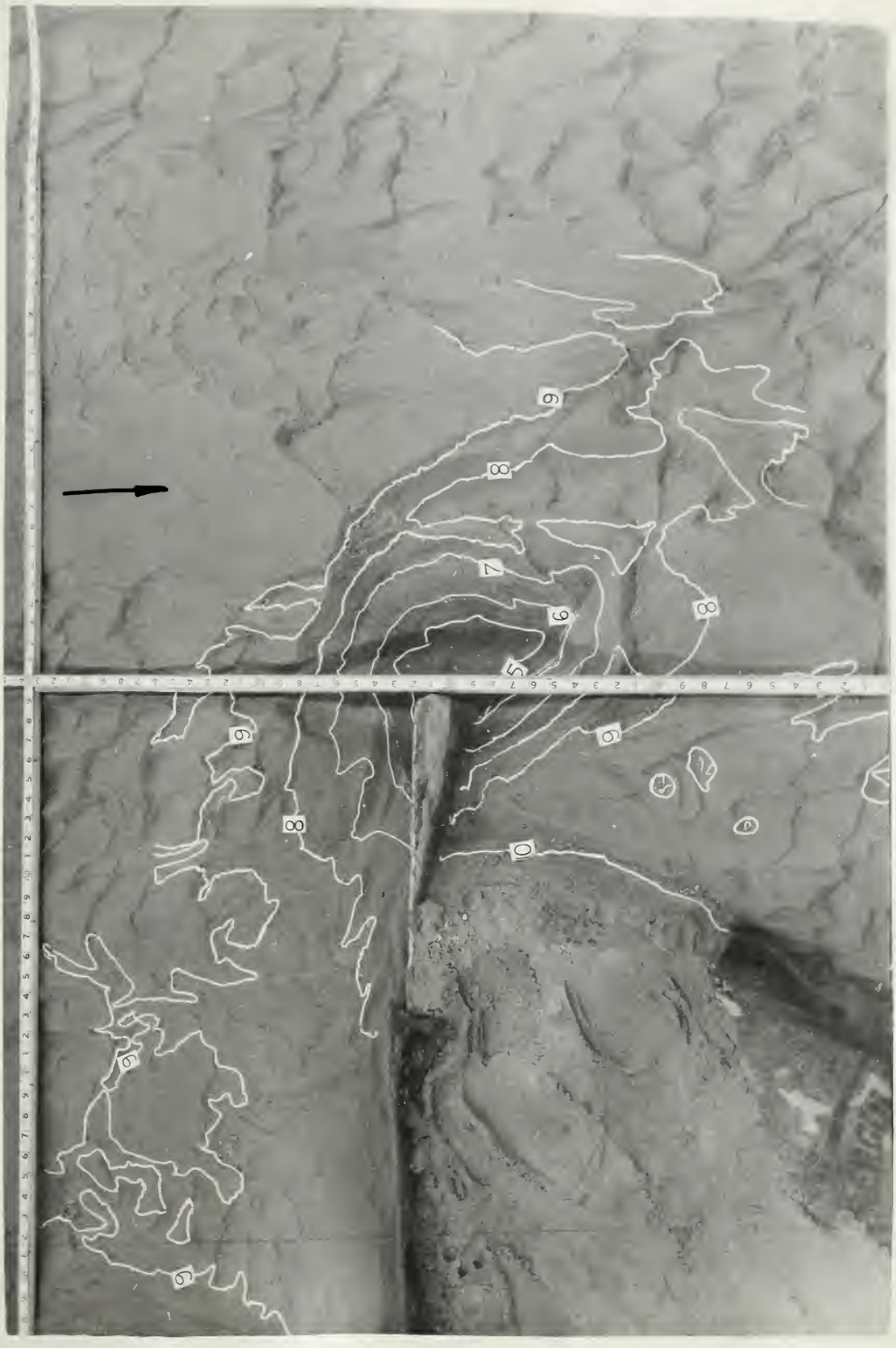


FIG. 54 SCOUR TEST 3 SPUR 1

C.I. = 2 cm.

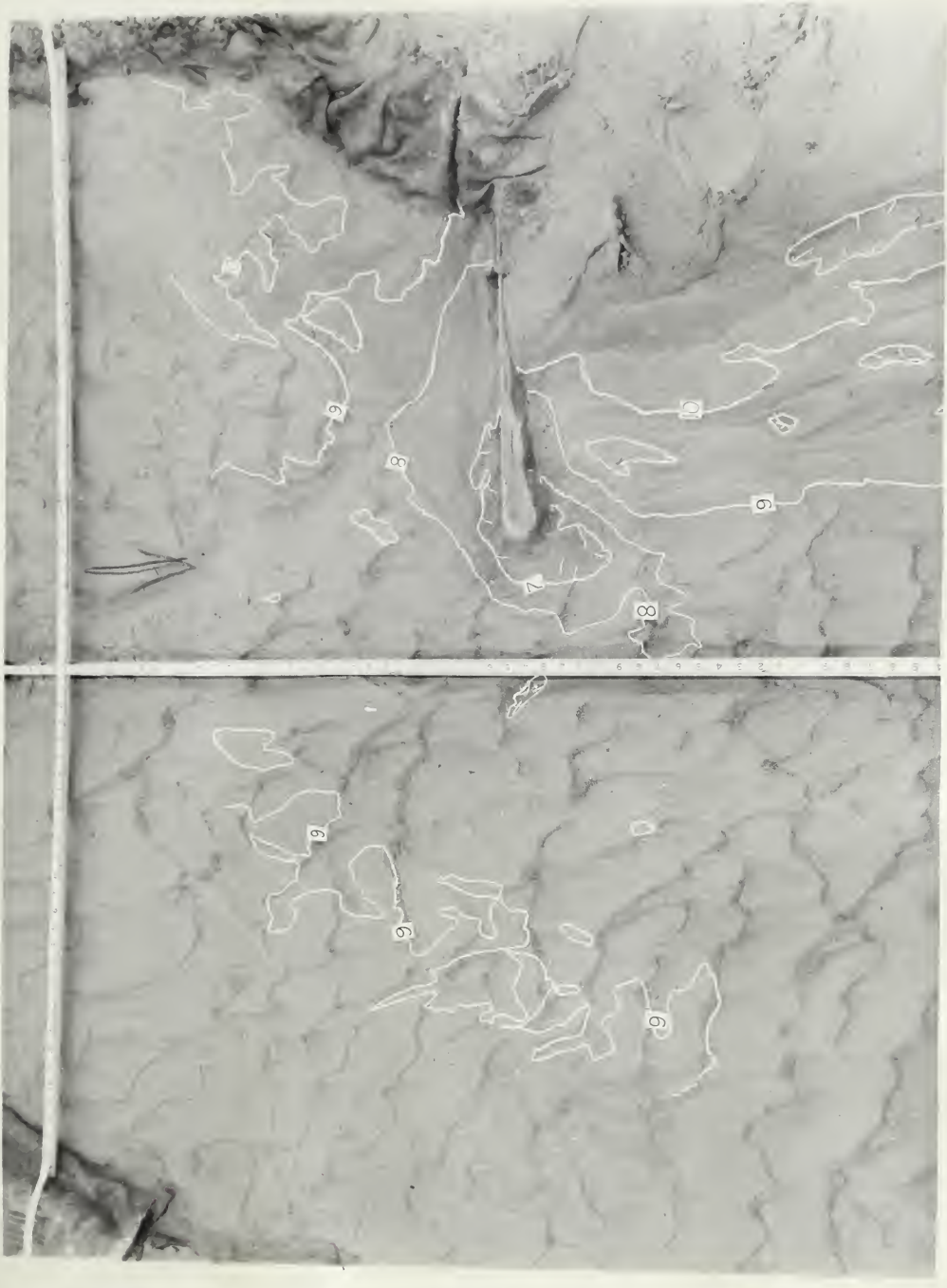


FIG. 55 SCOUR TEST 3 SPUR 2

C.I. = 2 cm.

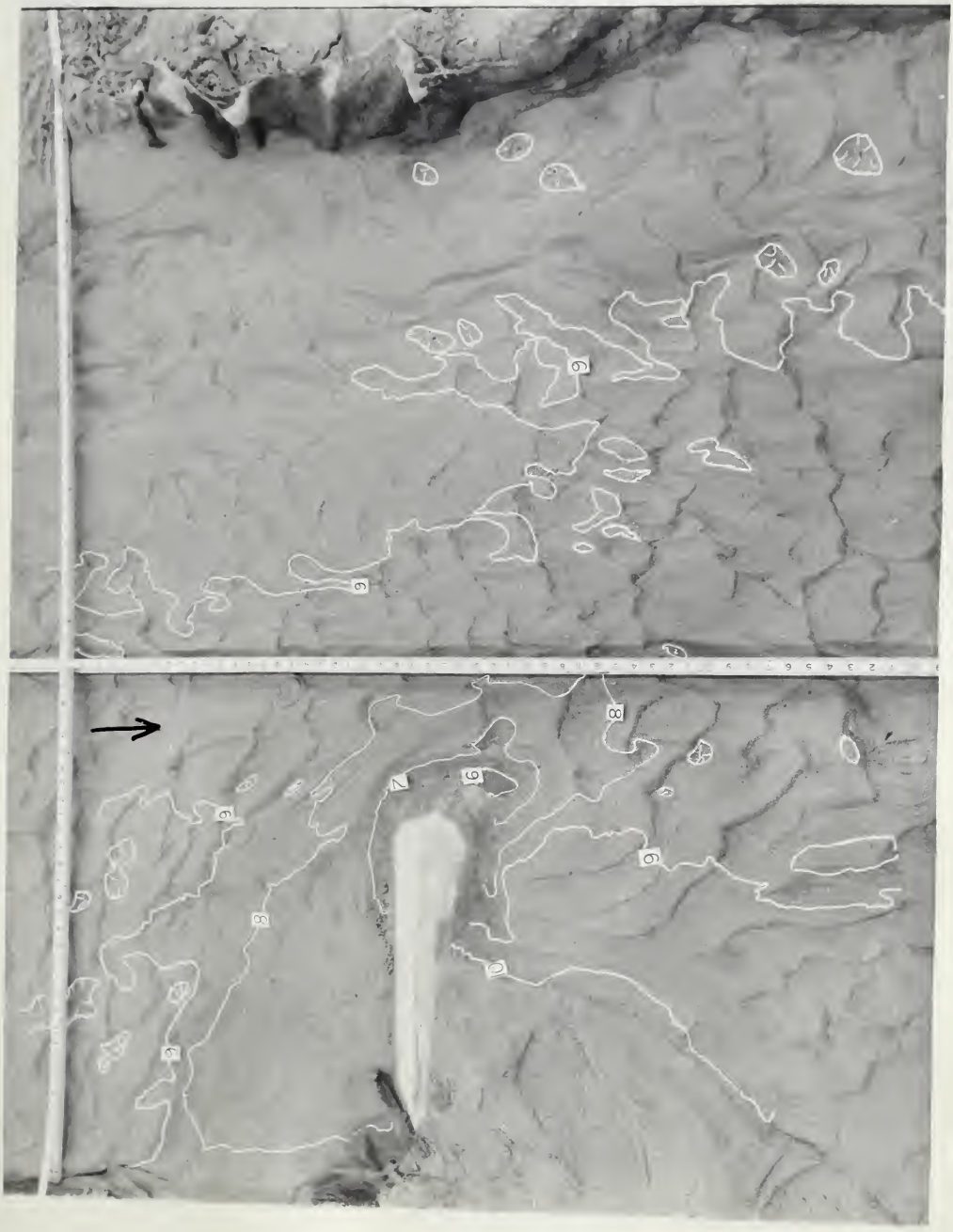


FIG. 56 SCOUR TEST 3 SPUR 3

C.I. = 2cm.

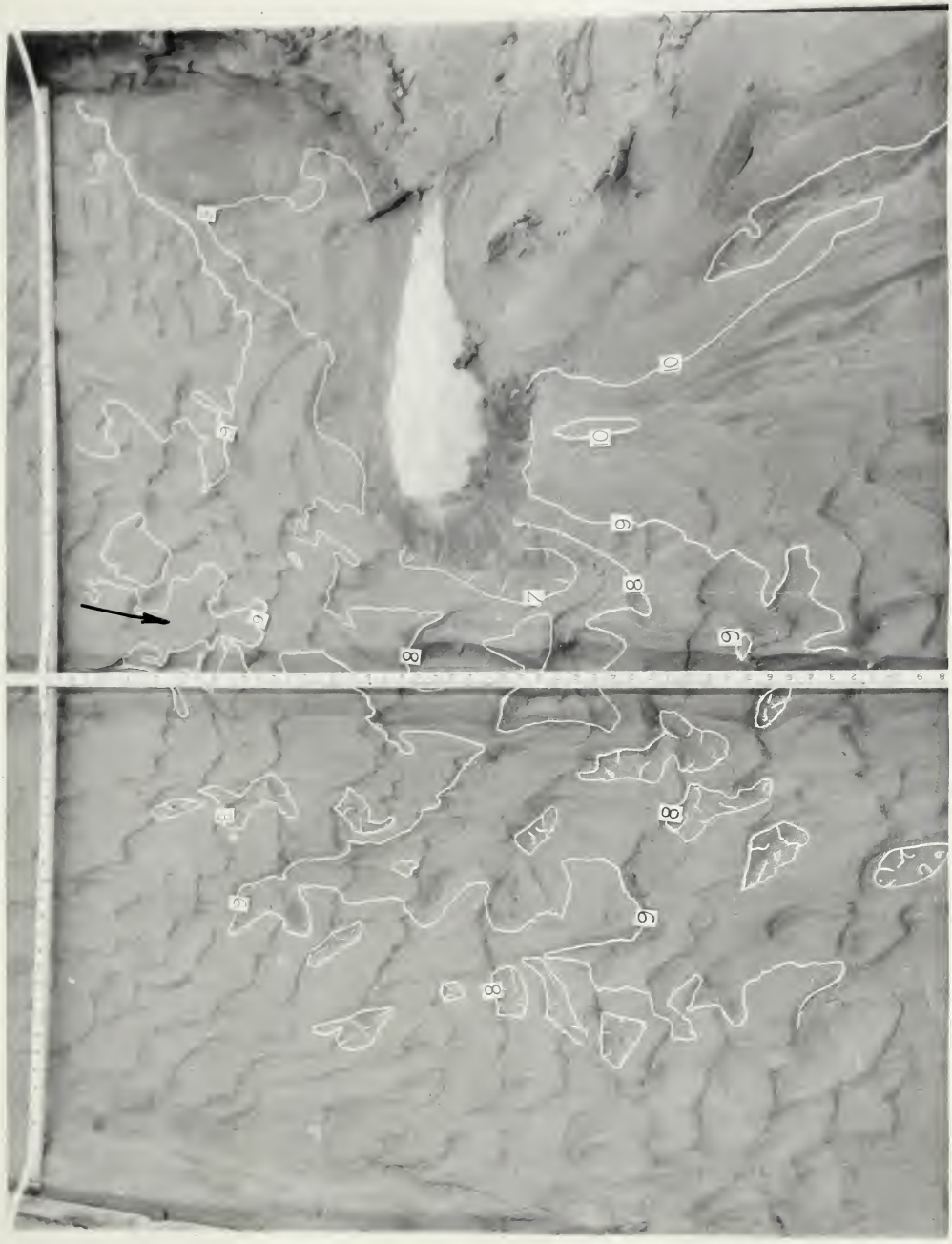
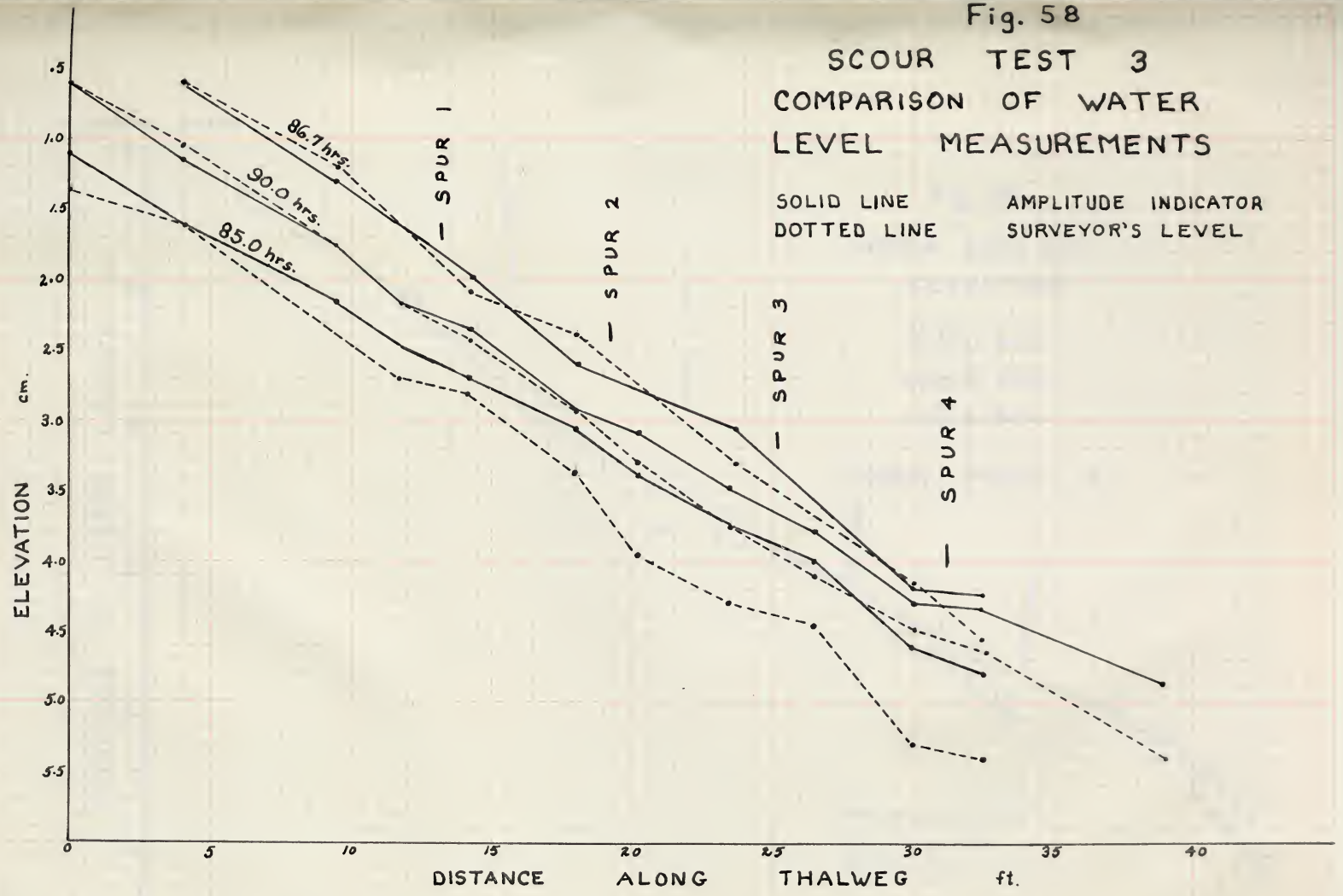
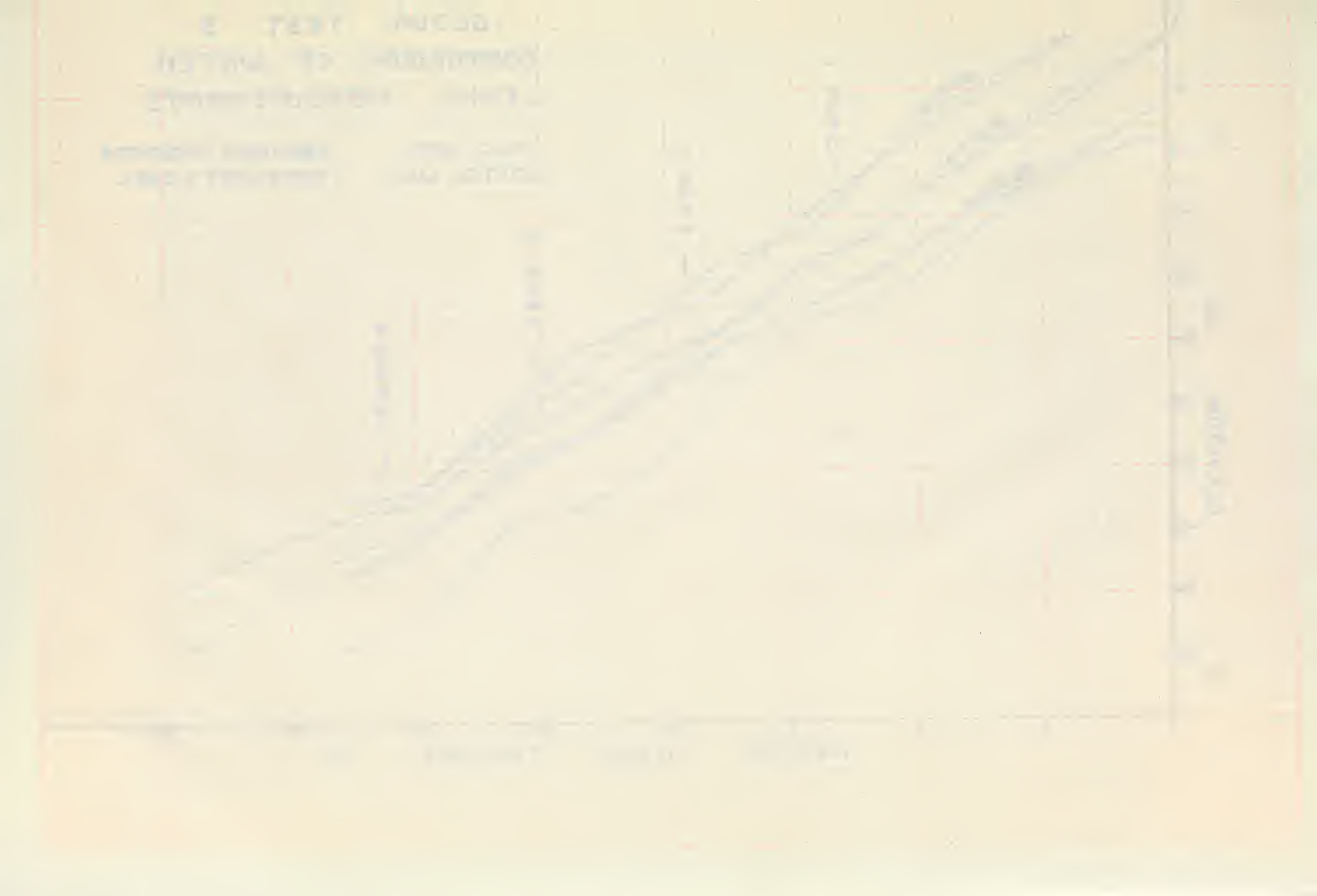


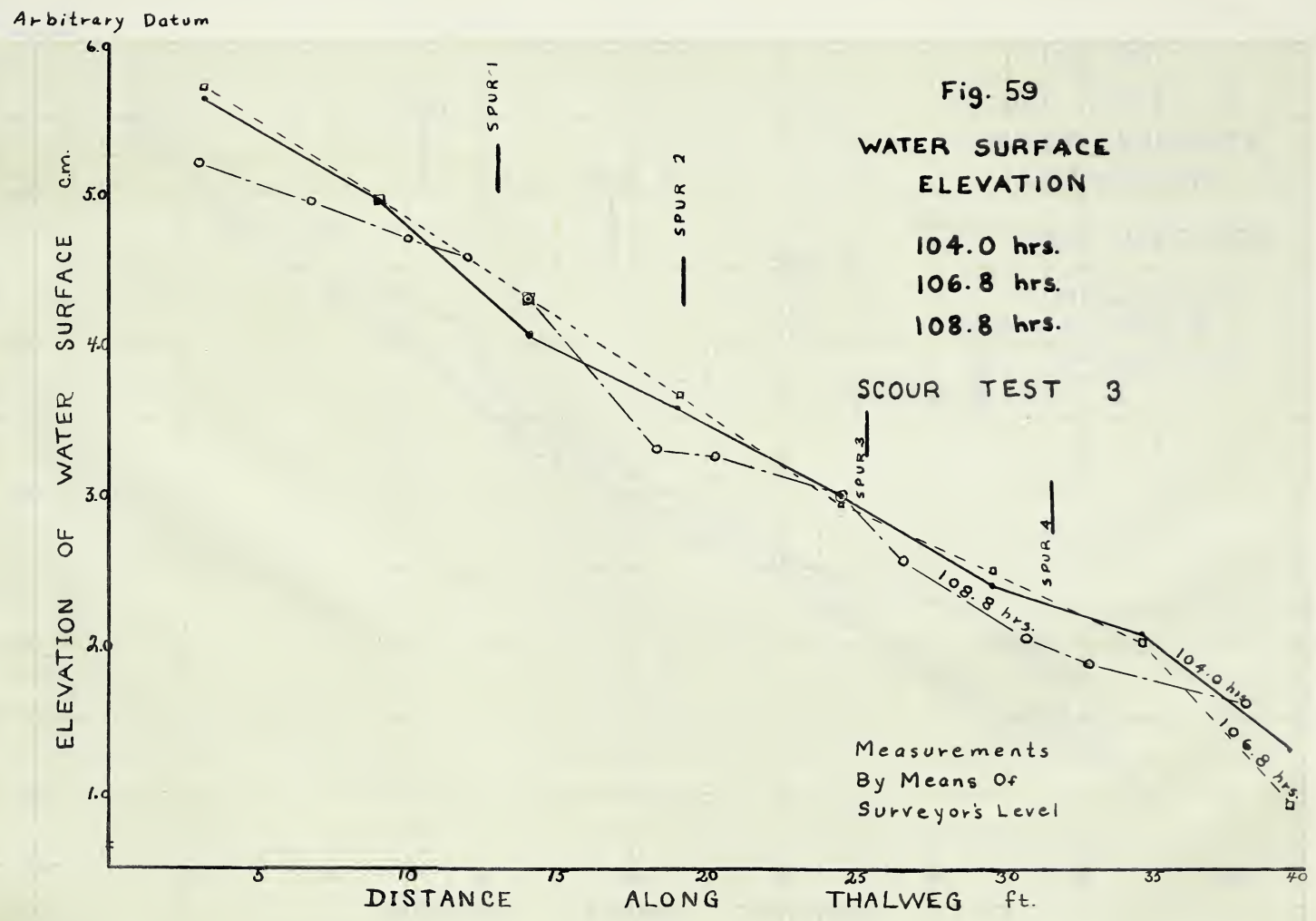
FIG. 57 SCOUR TEST 3 SPUR 4

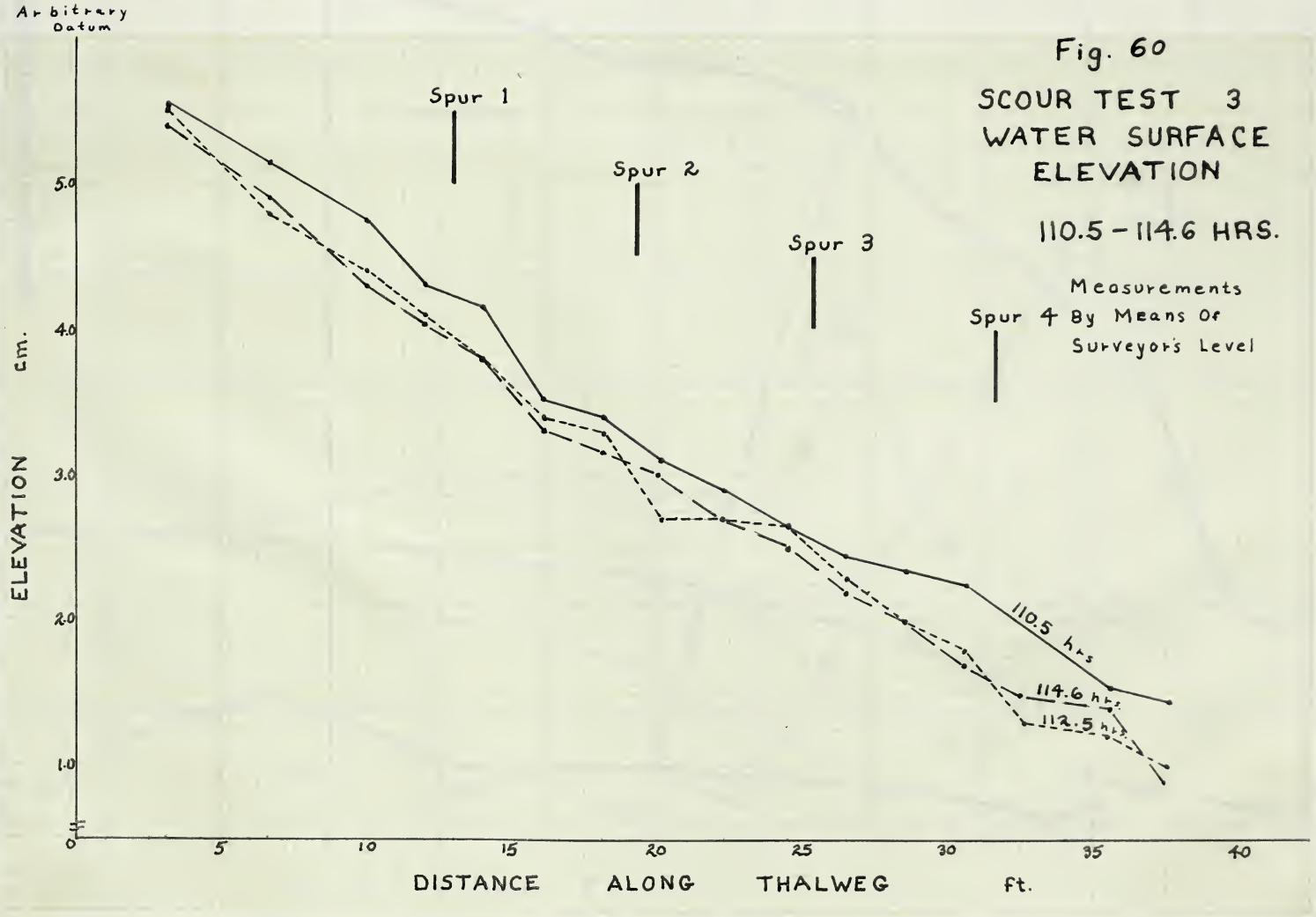
C. I. = 2 cm.

Fig. 58


SCOUR TEST 3
COMPARISON OF WATER LEVEL MEASUREMENTS
SOLID LINE AMPLITUDE INDICATOR
DOTTED LINE SURVEYOR'S LEVEL
86.7 hrs.
90.0 hrs.
85.0 hrs.
SPUR 1
SPUR 2
SPUR 3
SPUR 4
ELEVATION cm.
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
0
5
10
15
20
25
30
35
40
DISTANCE ALONG THALWEG ft.




Arbitrary Datum
6.0
5.0
4.0
3.0
2.0
1.0
ELEVATION OF WATER SURFACE c.m.
SPUR 1
SPUR 2
SPUR 3
SPUR 4
Fig. 59
WATER SURFACE ELEVATION
104.0 hrs.
106.8 hrs.
108.8 hrs.
SCOUR TEST 3
108.8 hrs.
104.0 hrs.
106.8 hrs.
Measurements By Means Of Surveyor's Level
5
10
15
20
25
30
35
40
DISTANCE ALONG THALWEG ft.


Arbitrary Datum
Fig. 60
SCOUR TEST 3
WATER SURFACE ELEVATION
110.5 - 114.6 HRS.
Measurements By Means Of Surveyor's Level
Spur 1
Spur 2
Spur 3
Spur 4
ELEVATION cm.
5.0
4.0
3.0
2.0
1.0
0
110.5 hrs
114.6 hrs
112.5 hrs
5
10
15
20
25
30
35
40
DISTANCE ALONG THALWEG ft.

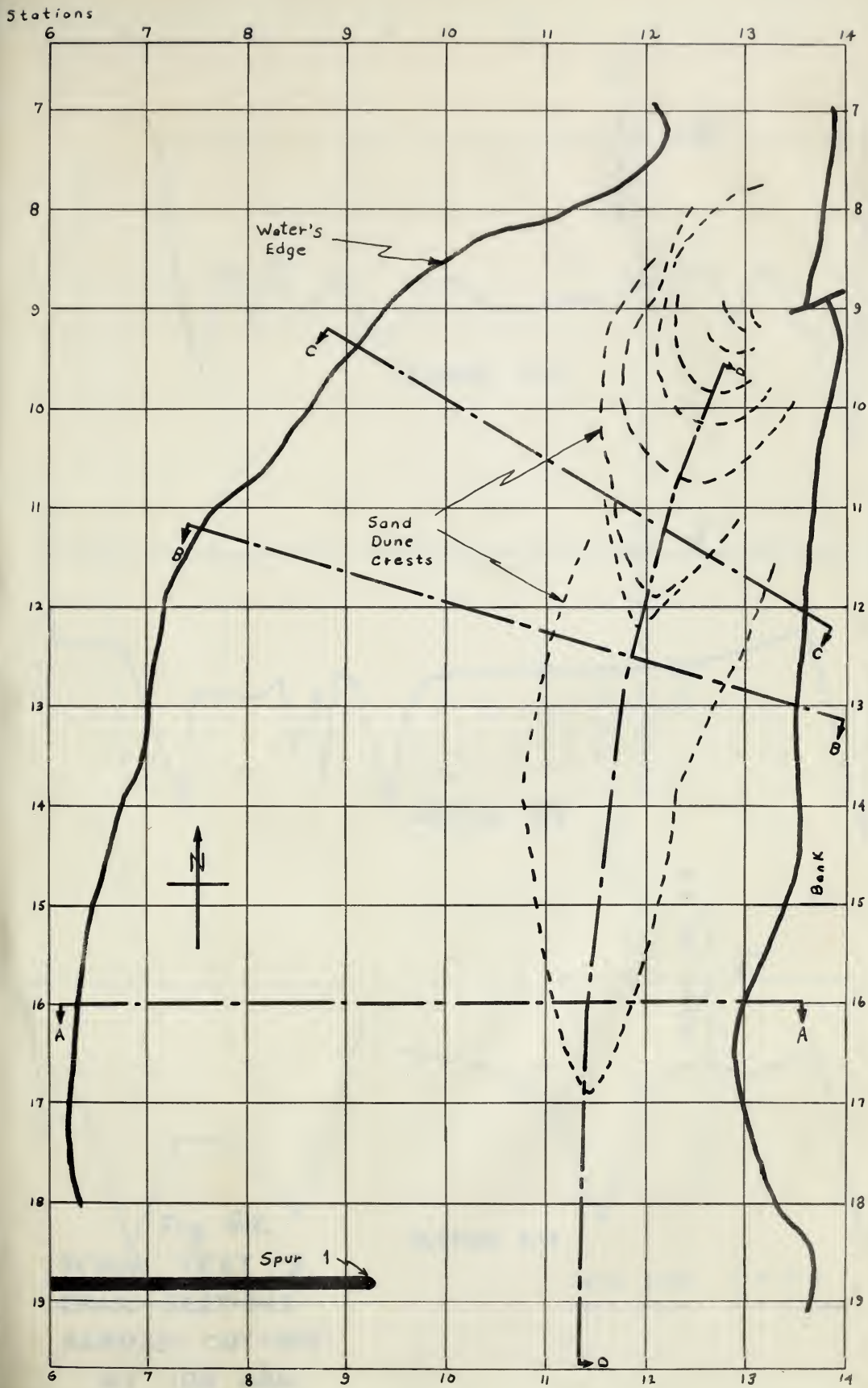


Fig. 61 SCOUR TEST 3
MAP OF CUT-OFF AREA 109 HRS.

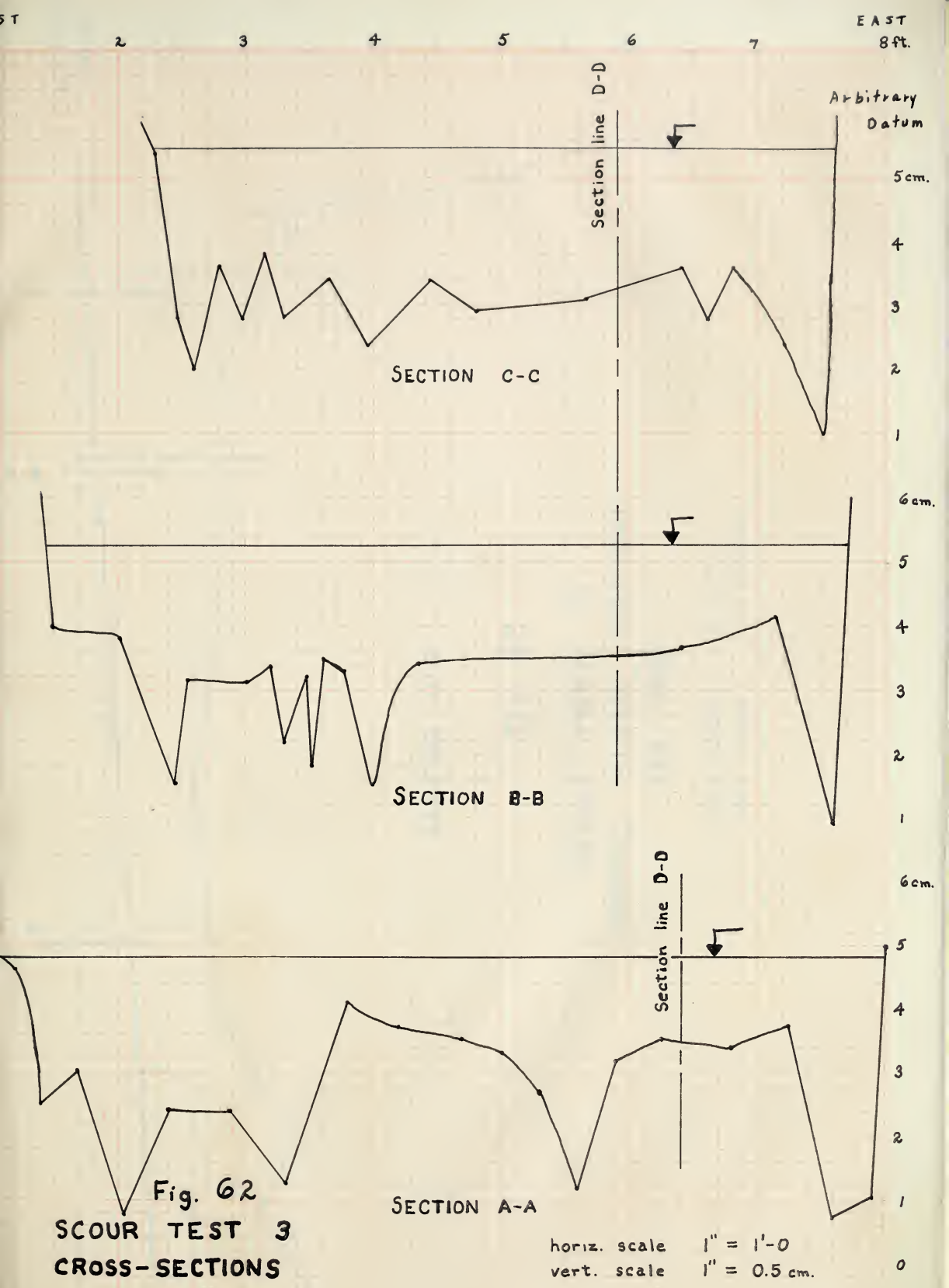
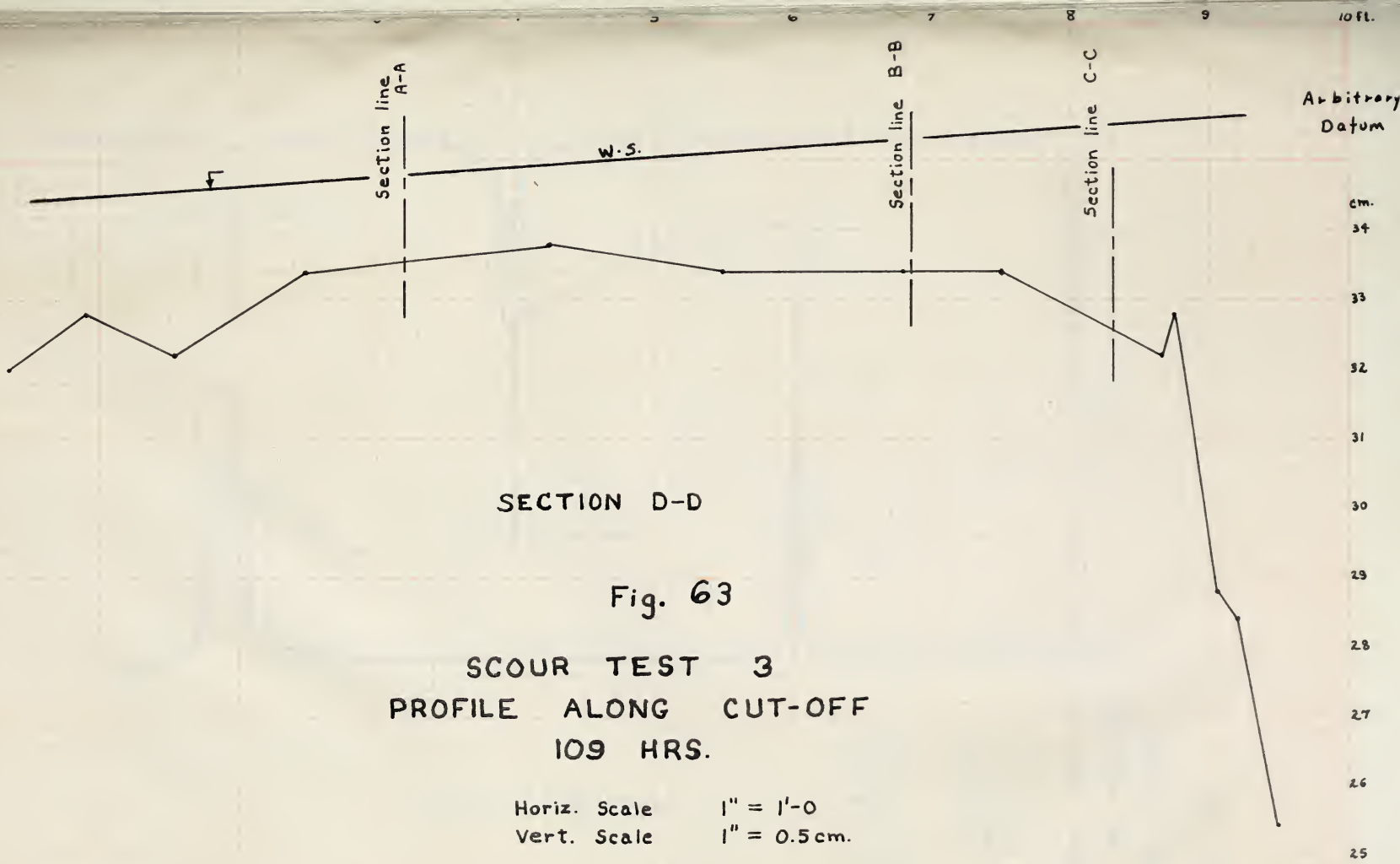


Fig. 62

SCOUR TEST 3
CROSS-SECTIONS
ACROSS CUT-OFF
AT 109 HRS.



SECTION D-D

Fig. 63

SCOUR TEST 3
PROFILE ALONG CUT-OFF
109 HRS.

Horiz. Scale 1" = 1'-0
Vert. Scale 1" = 0.5 cm.

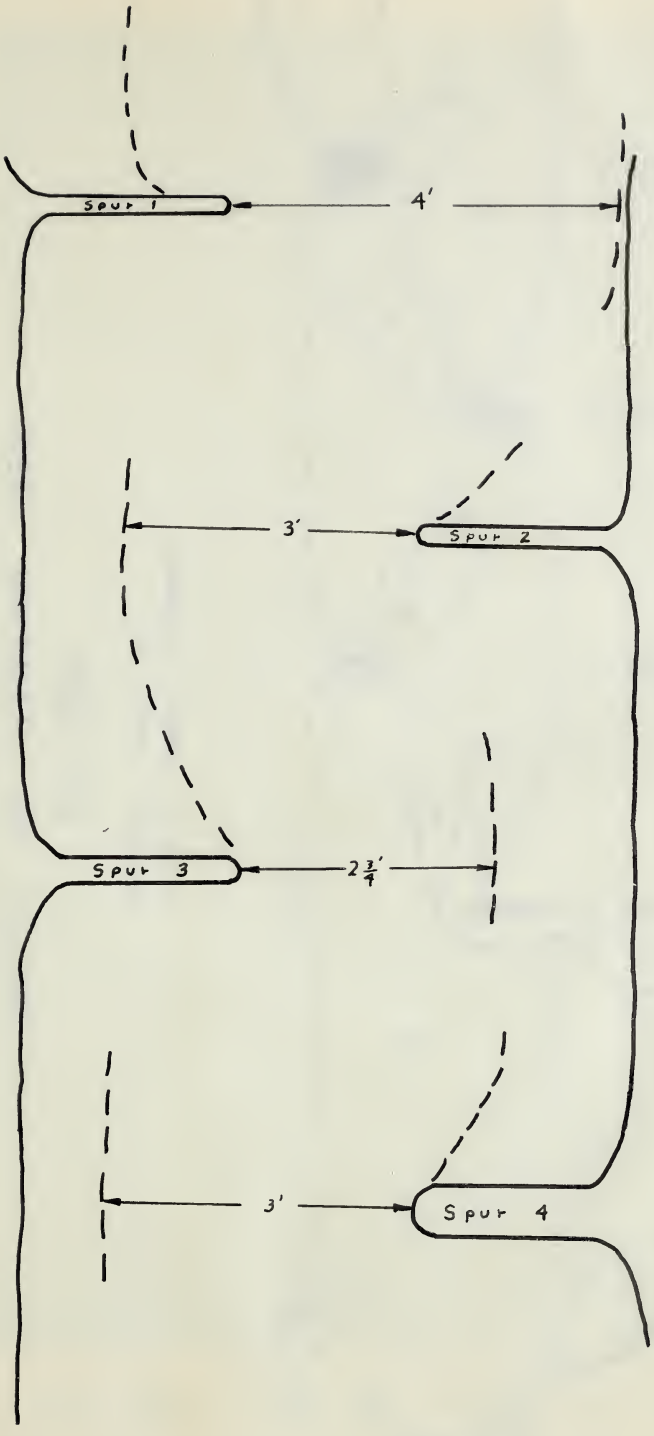


Fig. 64

SCOUR TEST 3
SKETCH OF AREA
OF BED MOVEMENT

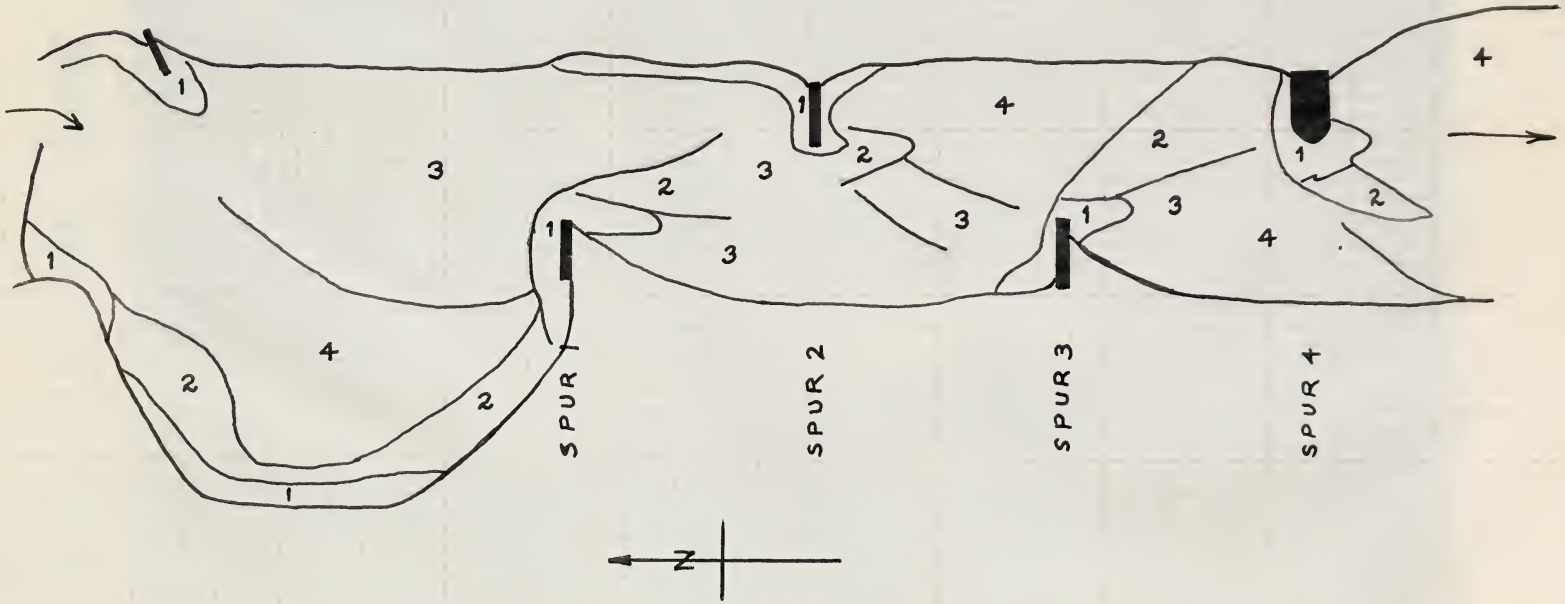
Dotted lines mark edge of noticeable bed movement

Scale 1" = 20"
(Distance between spurs not to scale)

Fig. 65

SCOUR TEST 3
SKETCH OF STREAM BED
22 HRS.

Numbers refer to
relative depths 1 = lowest



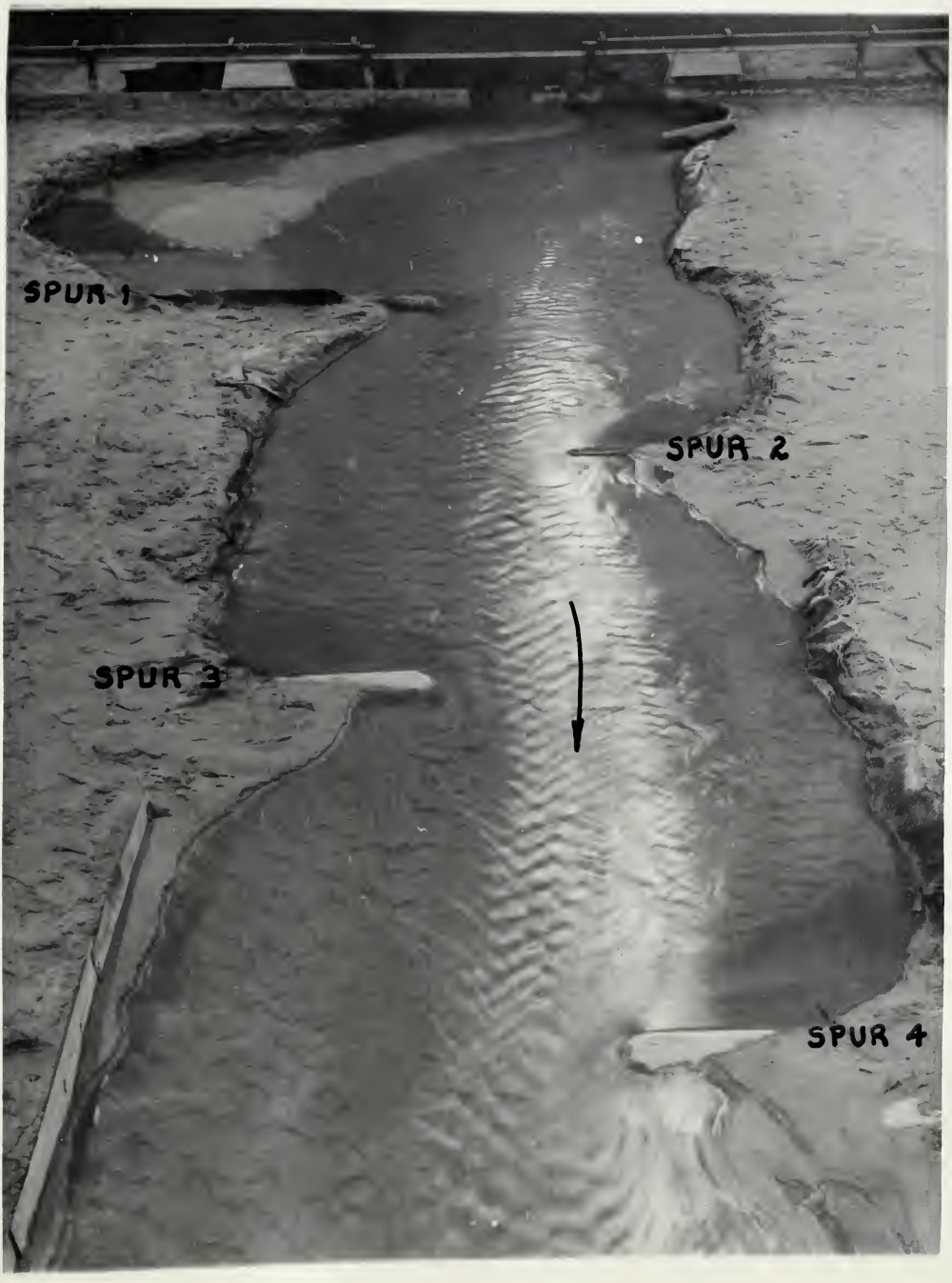


FIG. 66 SCOUR TEST 3 Q = 0.45 cfs.
118.4 hrs.

FIG. 67 SCOUR TEST 3 Q = 0.09 cfs.
118.4 hrs.

FIG. 68 SCOUR TEST 3 Q = 0.045 cfs.

118.4 hrs.

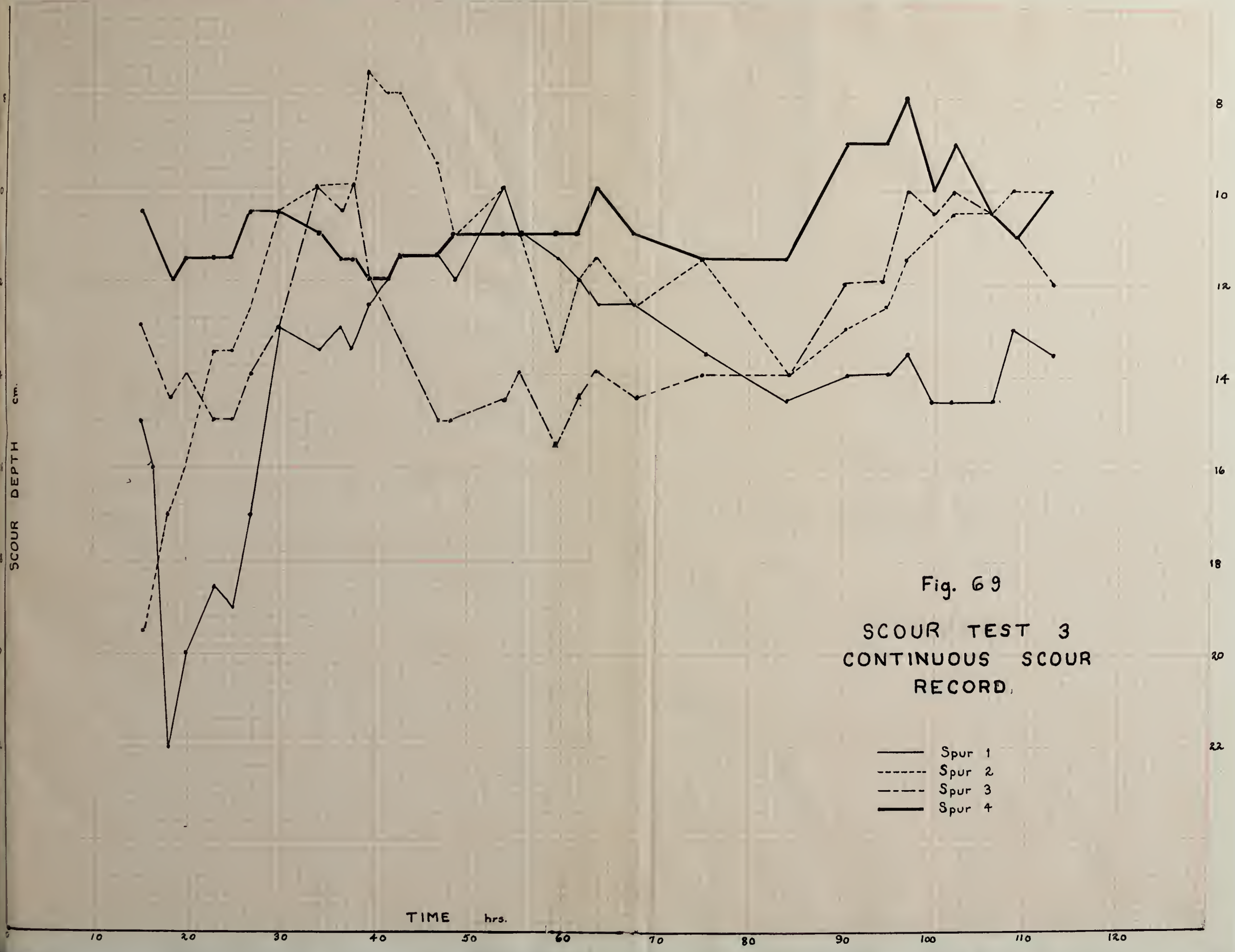


Fig. 69

SCOUR TEST 3
CONTINUOUS SCOUR
RECORD.

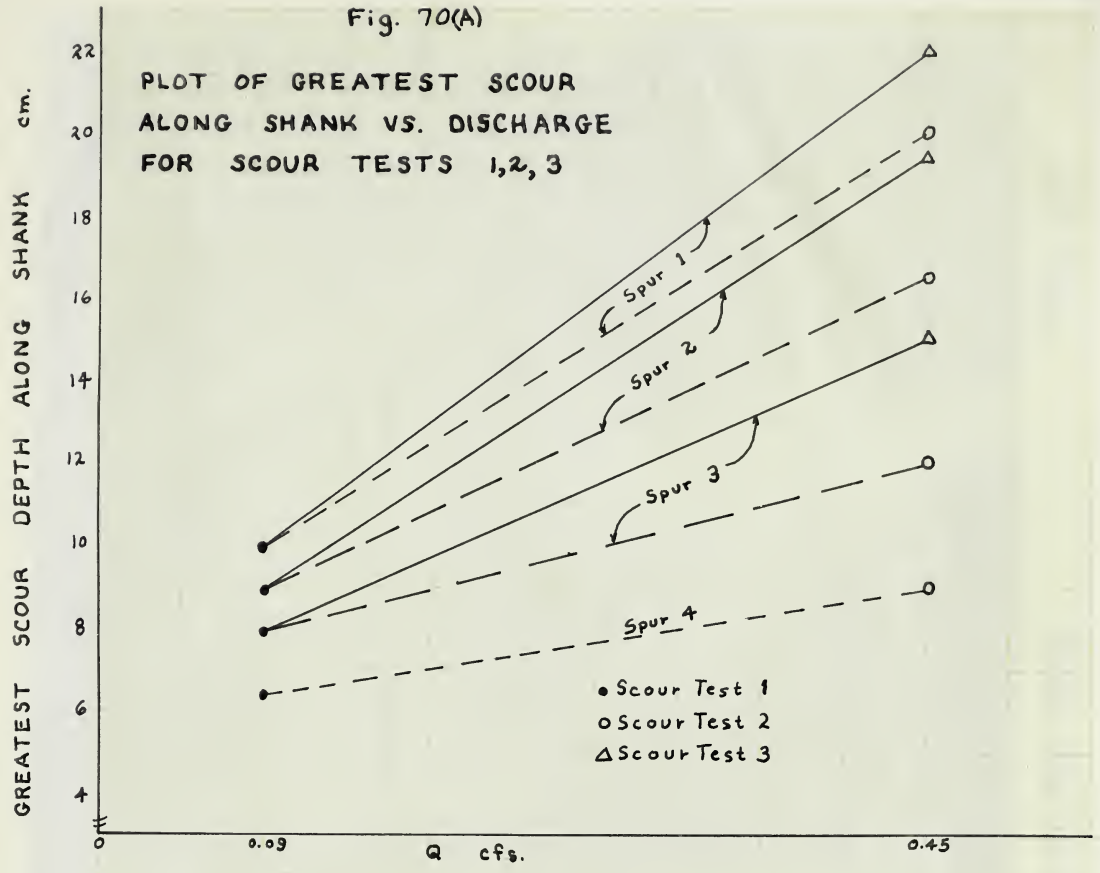


Fig. 70(A)
PLOT OF GREATEST SCOUR ALONG SHANK VS. DISCHARGE FOR SCOUR TESTS 1,2,3
GREATEST SCOUR DEPTH ALONG SHANK cm.
22
20
18
16
14
12
10
8
6
4
0
0.09
Q cfs.
0.45
Spur 1
Spur 2
Spur 3
Spur 4
• Scour Test 1
o Scour Test 2
Δ Scour Test 3

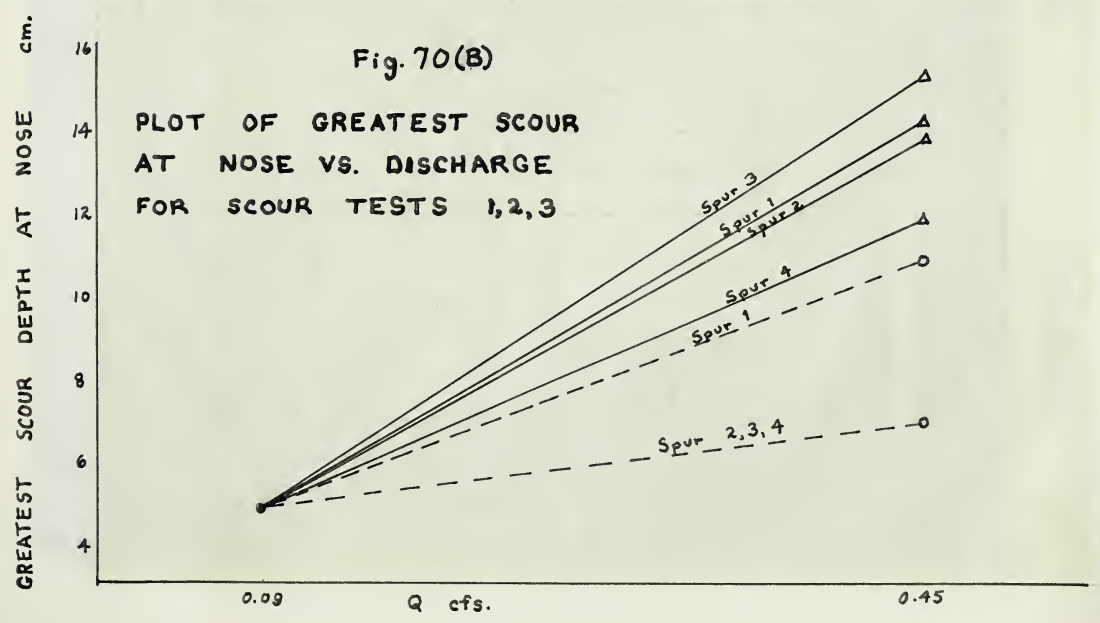
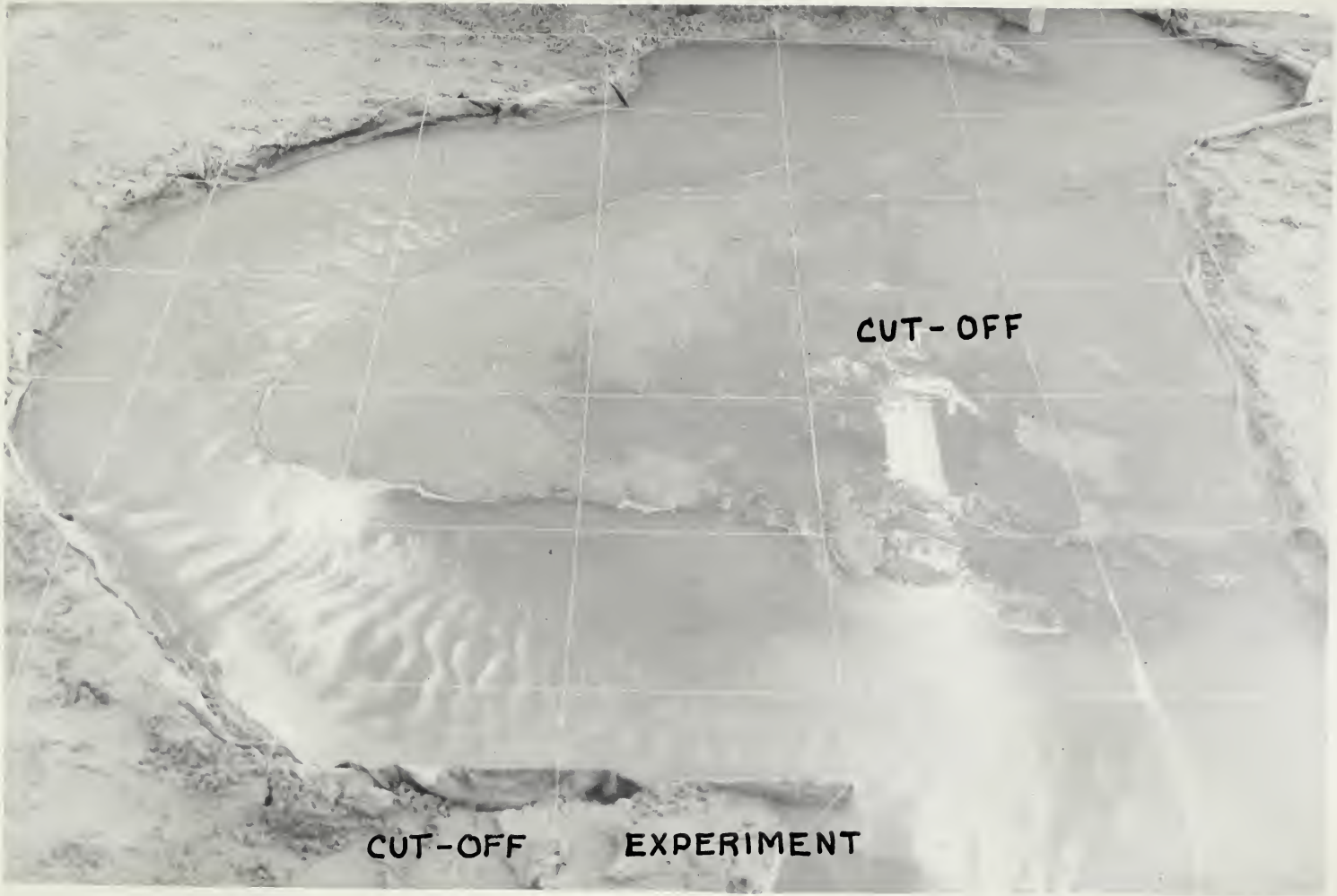
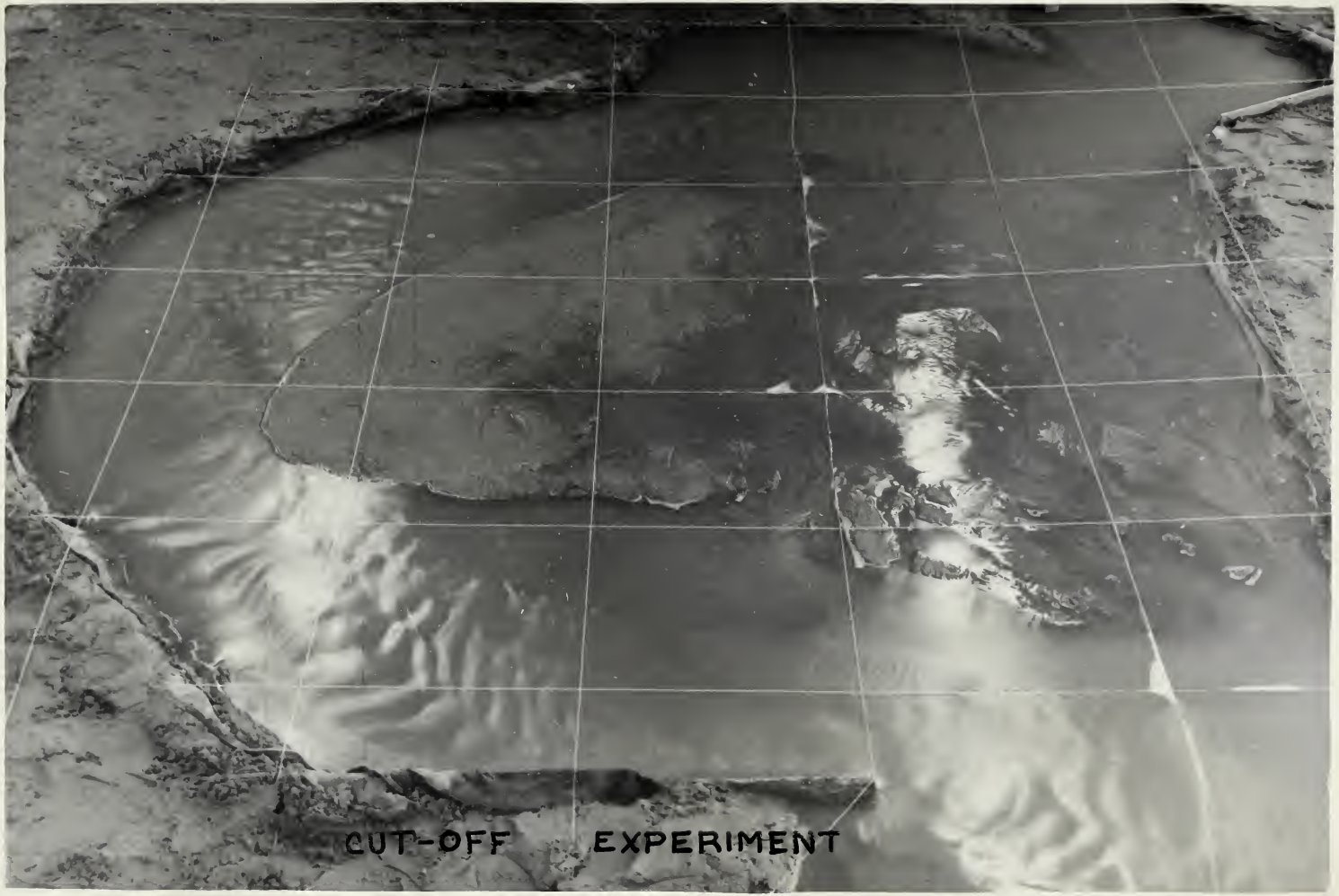


Fig. 70(B)
PLOT OF GREATEST SCOUR AT NOSE VS. DISCHARGE FOR SCOUR TESTS 1,2,3
GREATEST SCOUR DEPTH AT NOSE cm.
16
14
12
10
8
6
4
0.09
Q cfs.
0.45
Spur 3
Spur 1
Spur 2
Spur 4
Spur 1
Spur 2,3,4

TIME = 0 Q = 0.45 CFS. FIG. 71



TIME = 5 MIN. Q = 0.45 CFS. FIG. 72



TIME = 20 MIN. Q = 0.45 CFS. FIG. 73

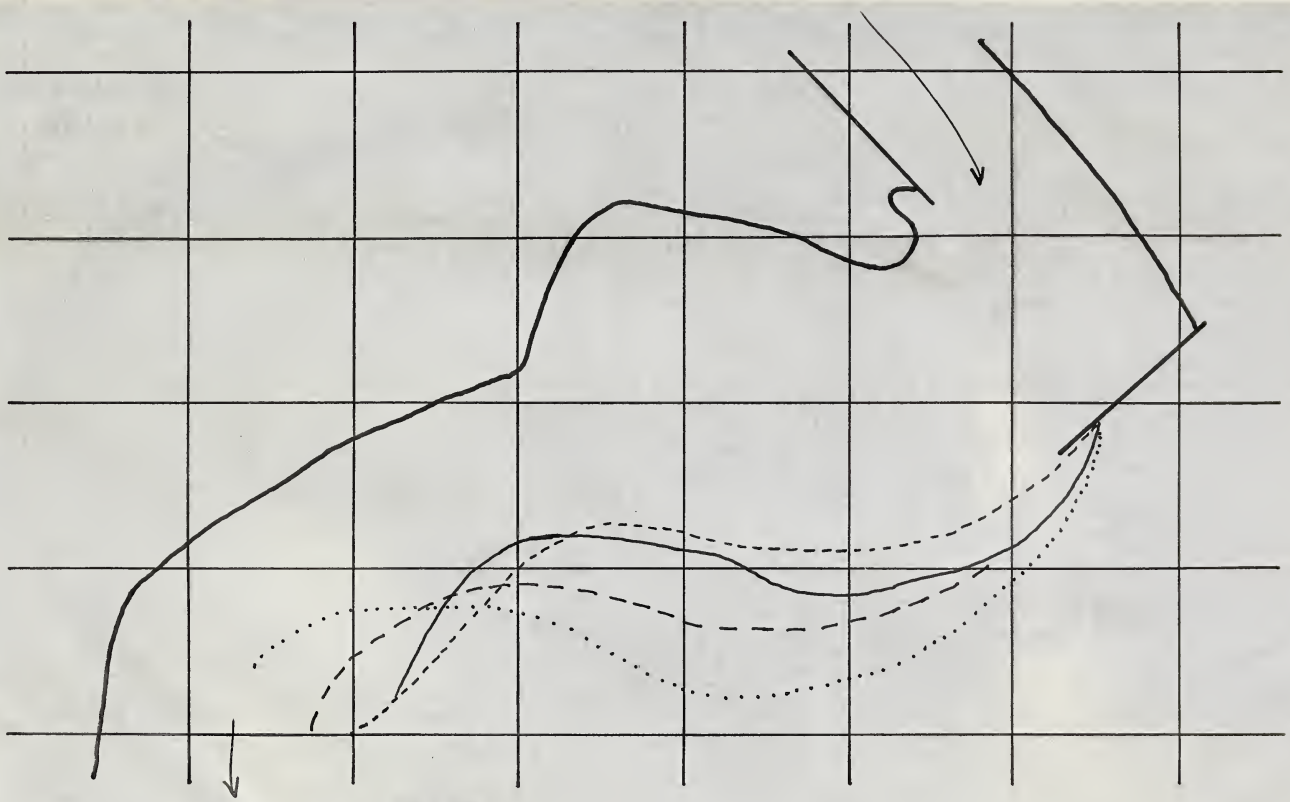
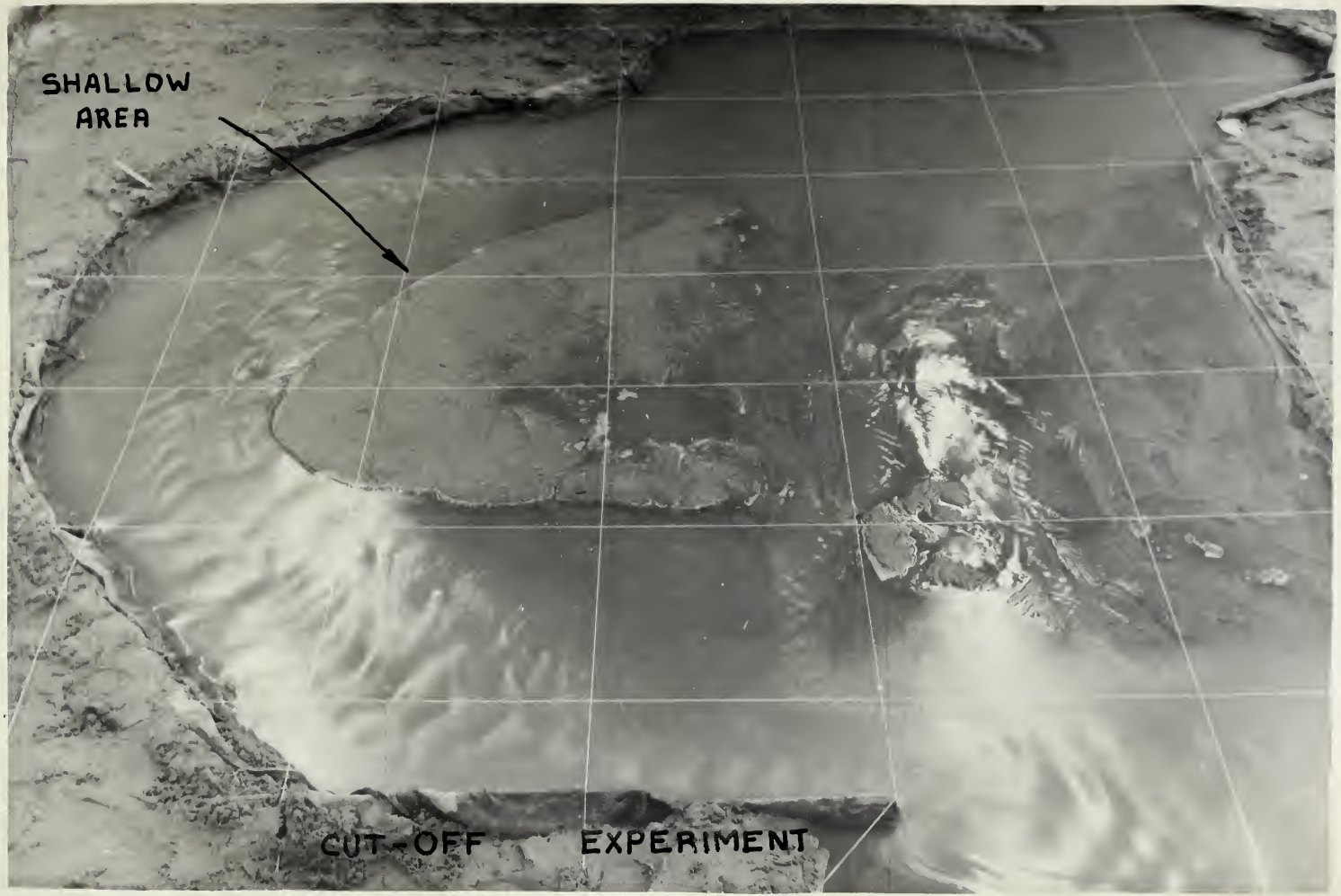
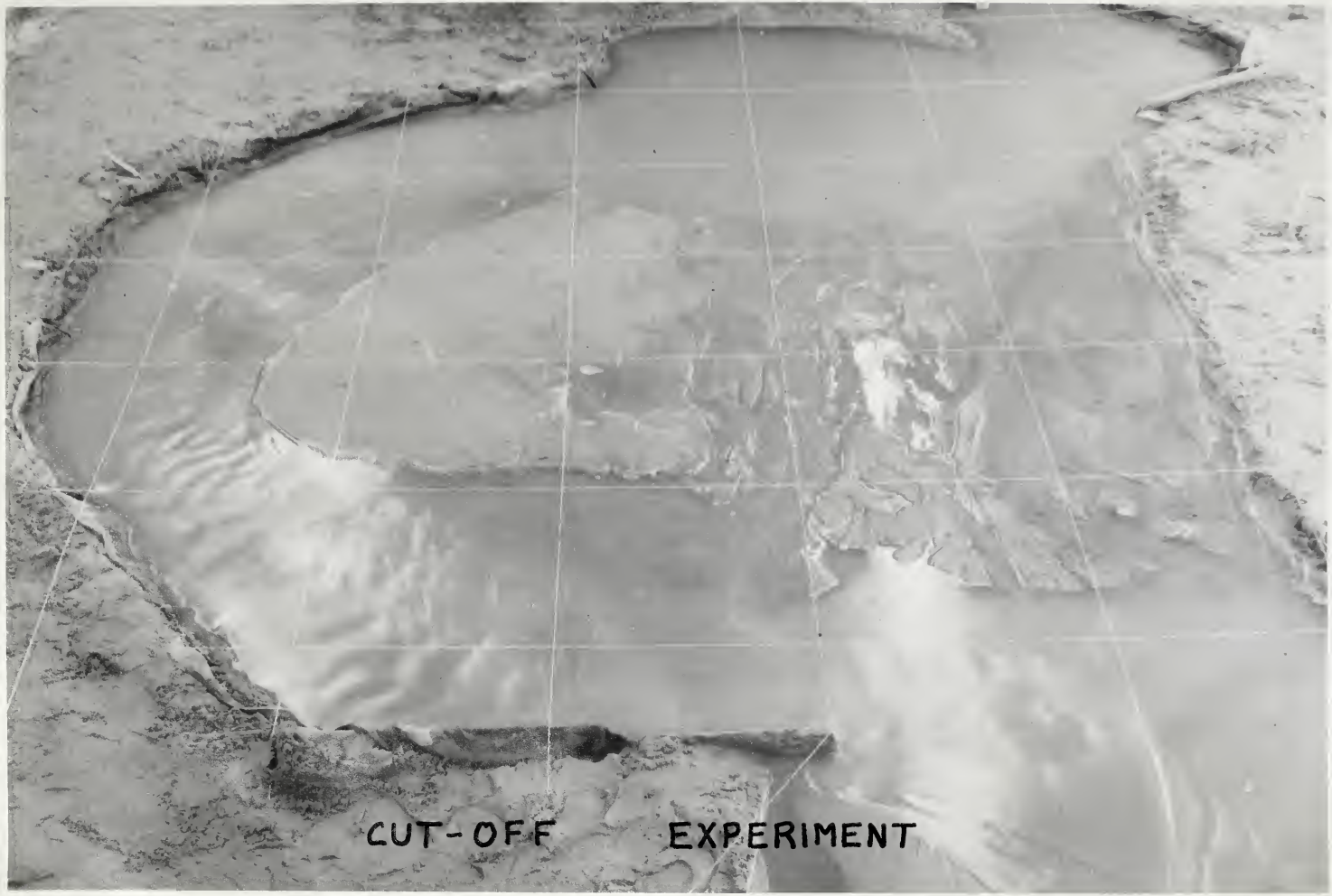


Fig. 74

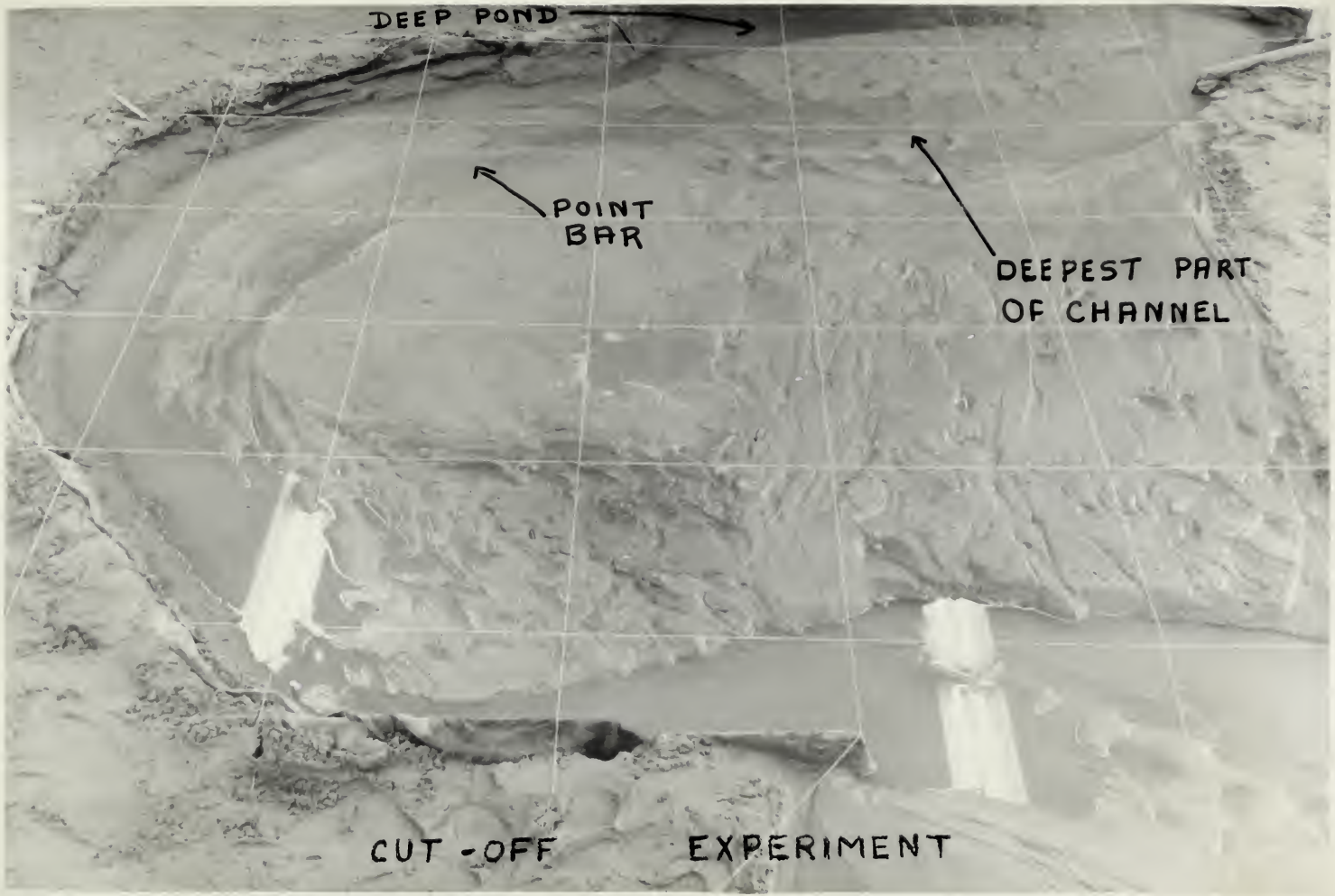
SKETCH OF CUT-OFF
SHOWING EDGE OF DEEP WATER



TIME = 2 HRS. Q = 0.45 CFS. FIG. 75



TIME = 3 HRS. Q = 0.45 CFS. FIG. 76



TIME = 3.5 HRS. Q - VERY SMALL FIG. 77

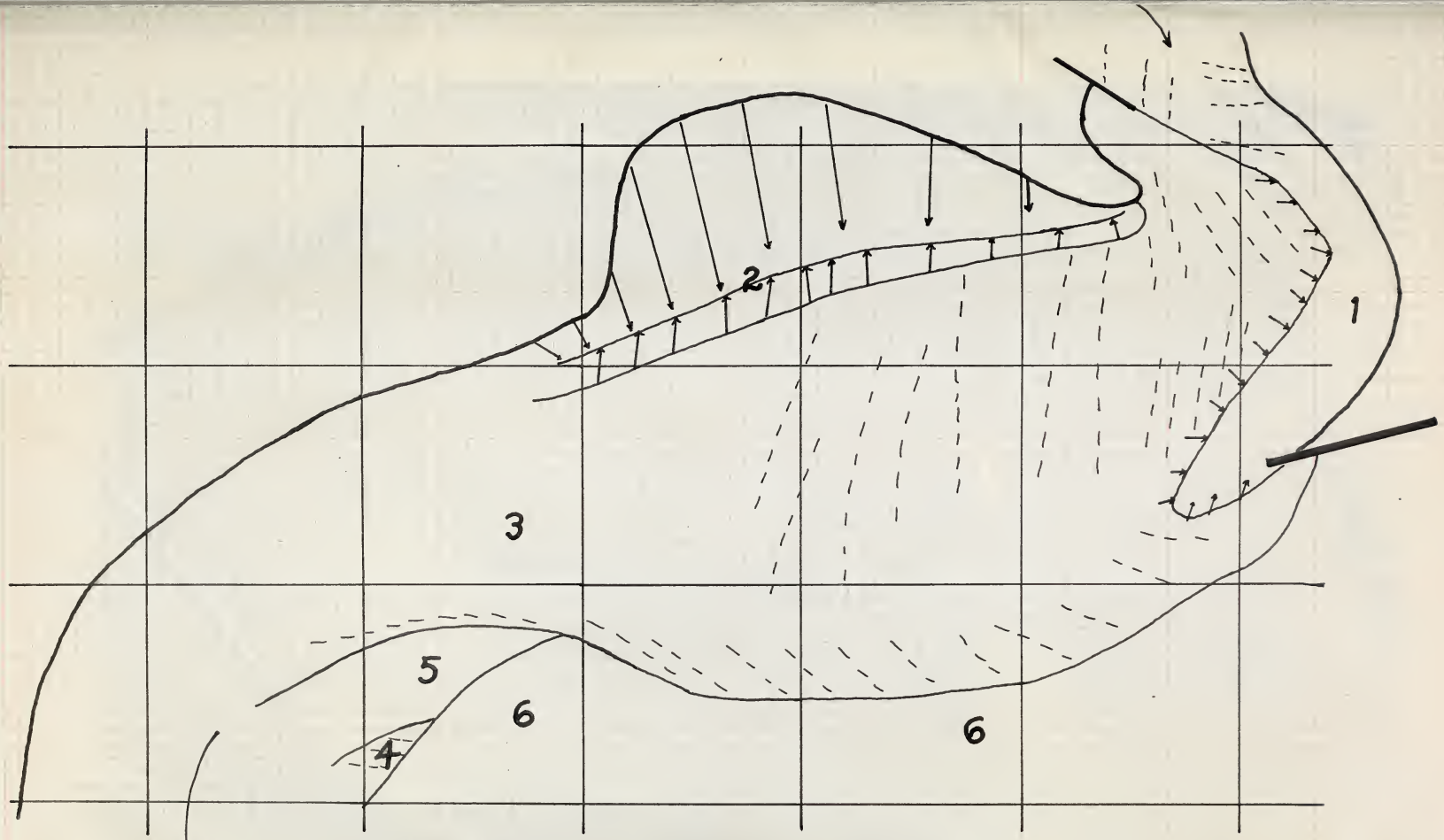
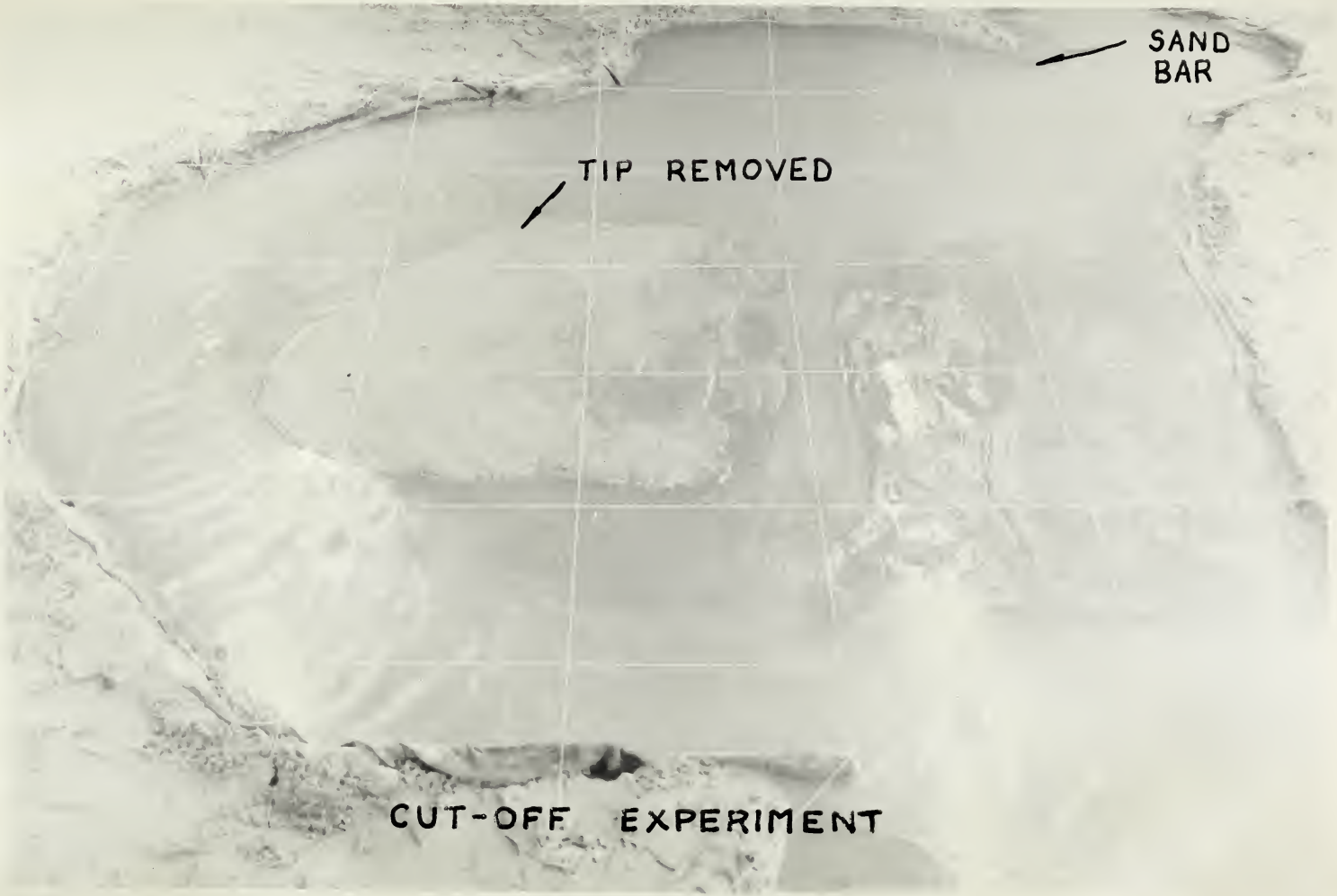


Fig. 78

SKETCH OF CUT-OFF
AT 3.5 HRS.

↓↓↓ steep slope
|||| sand dune crests

Numbers refer to
elevation 1 = lowest



TIME = 4.5 HRS. Q = 0.35 – 0.45 CFS. FIG. 79

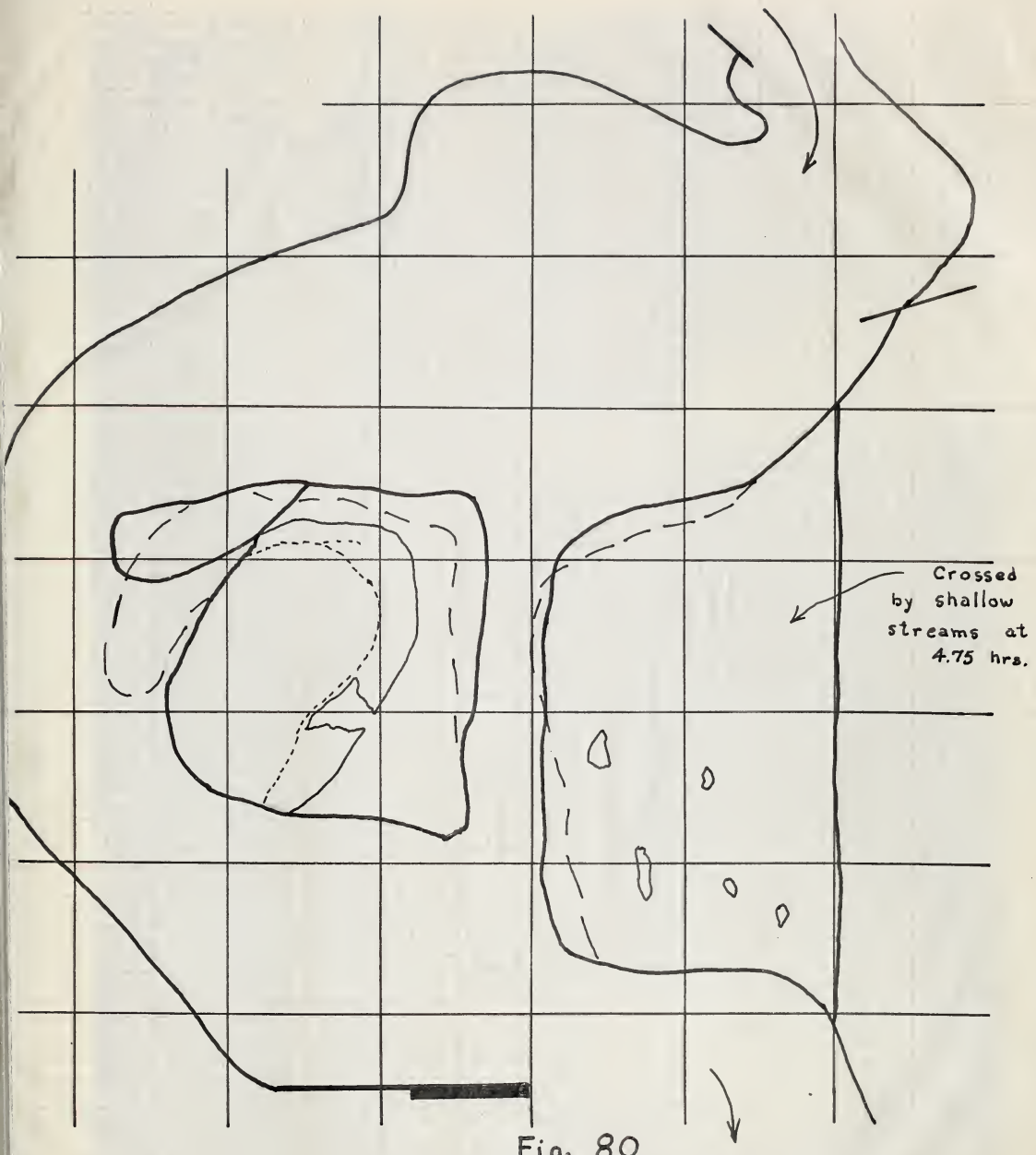
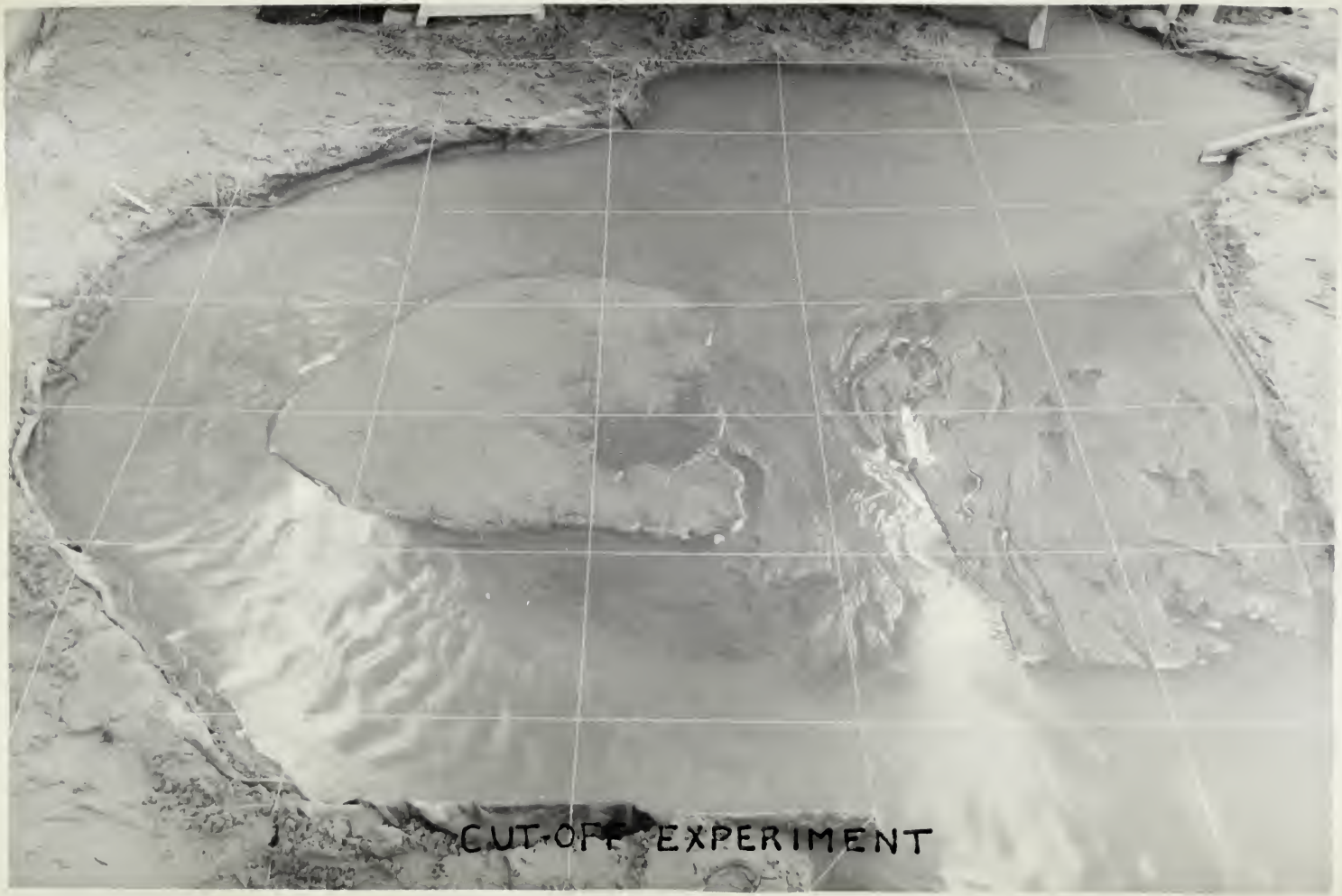


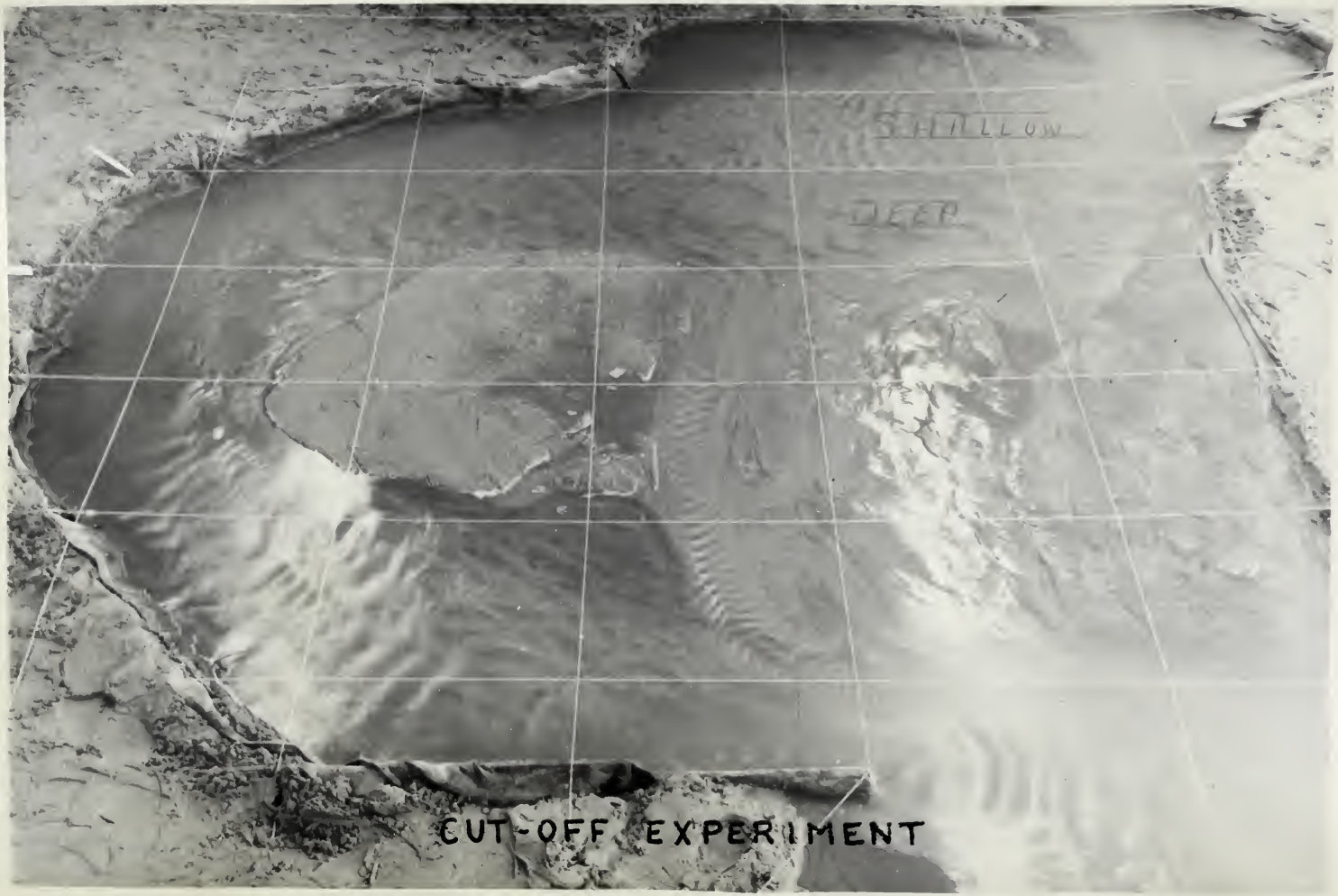
Fig. 80

SKETCH OF CUT-OFF
SHOWING WATER'S EDGE

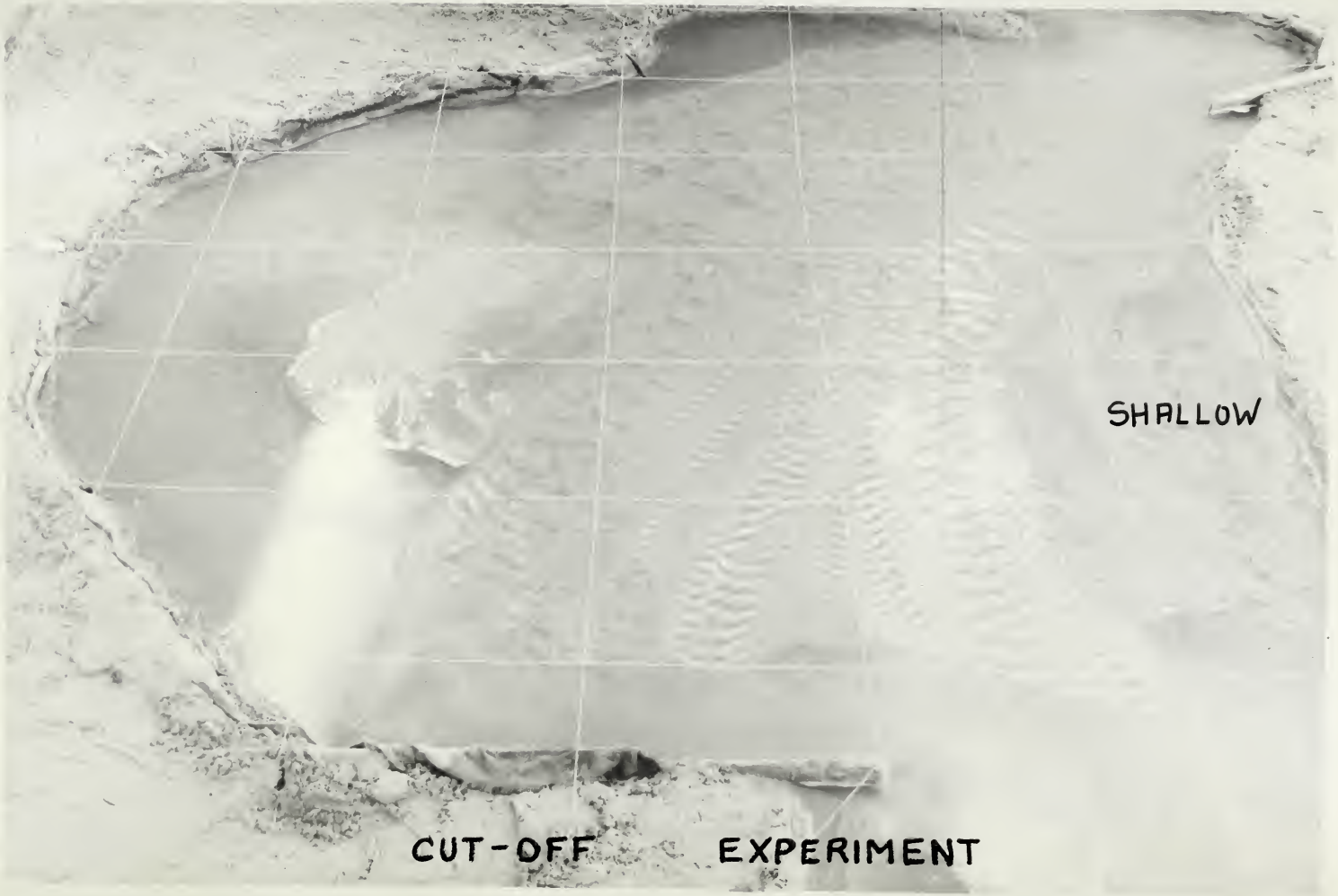
——— 4.75 hrs.
— — — 6.6 hrs.
——— 7.6 hrs.
------- 12.6 hrs.



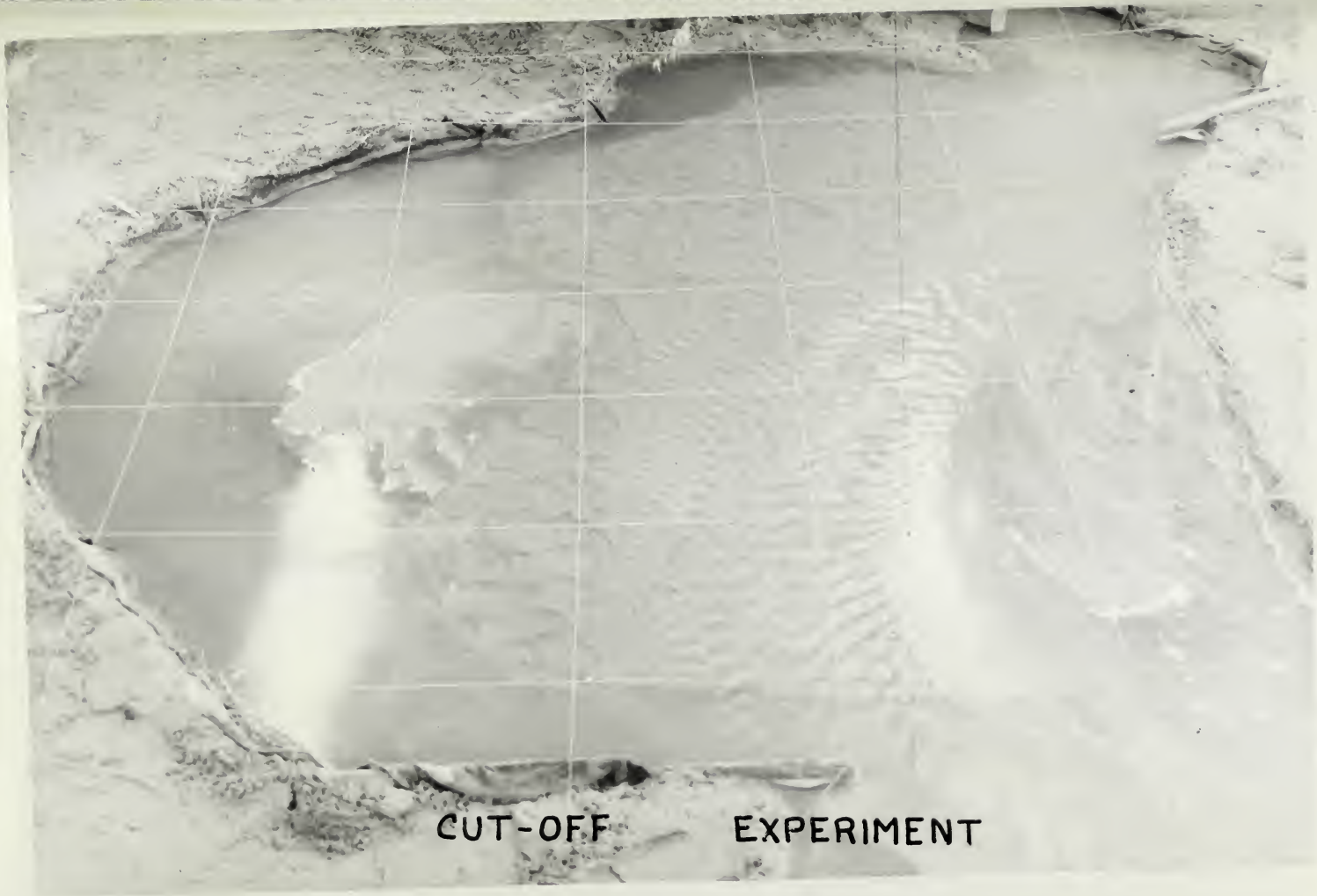
TIME = 6.5 HRS. Q = 0.35 – 0.45 CFS. FIG. 81



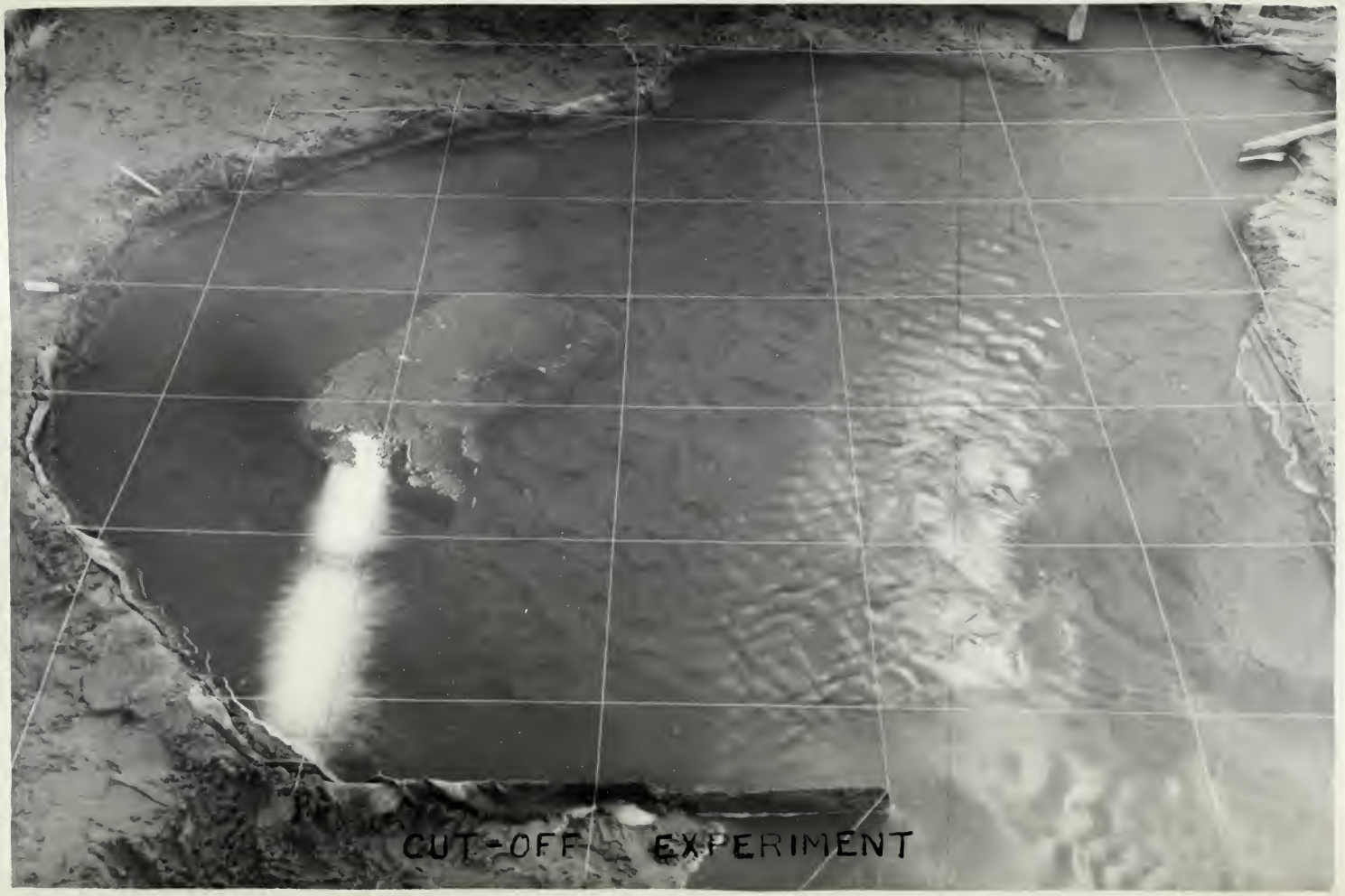
TIME = 7.1 HRS. Q = 0.45 CFS. FIG. 82



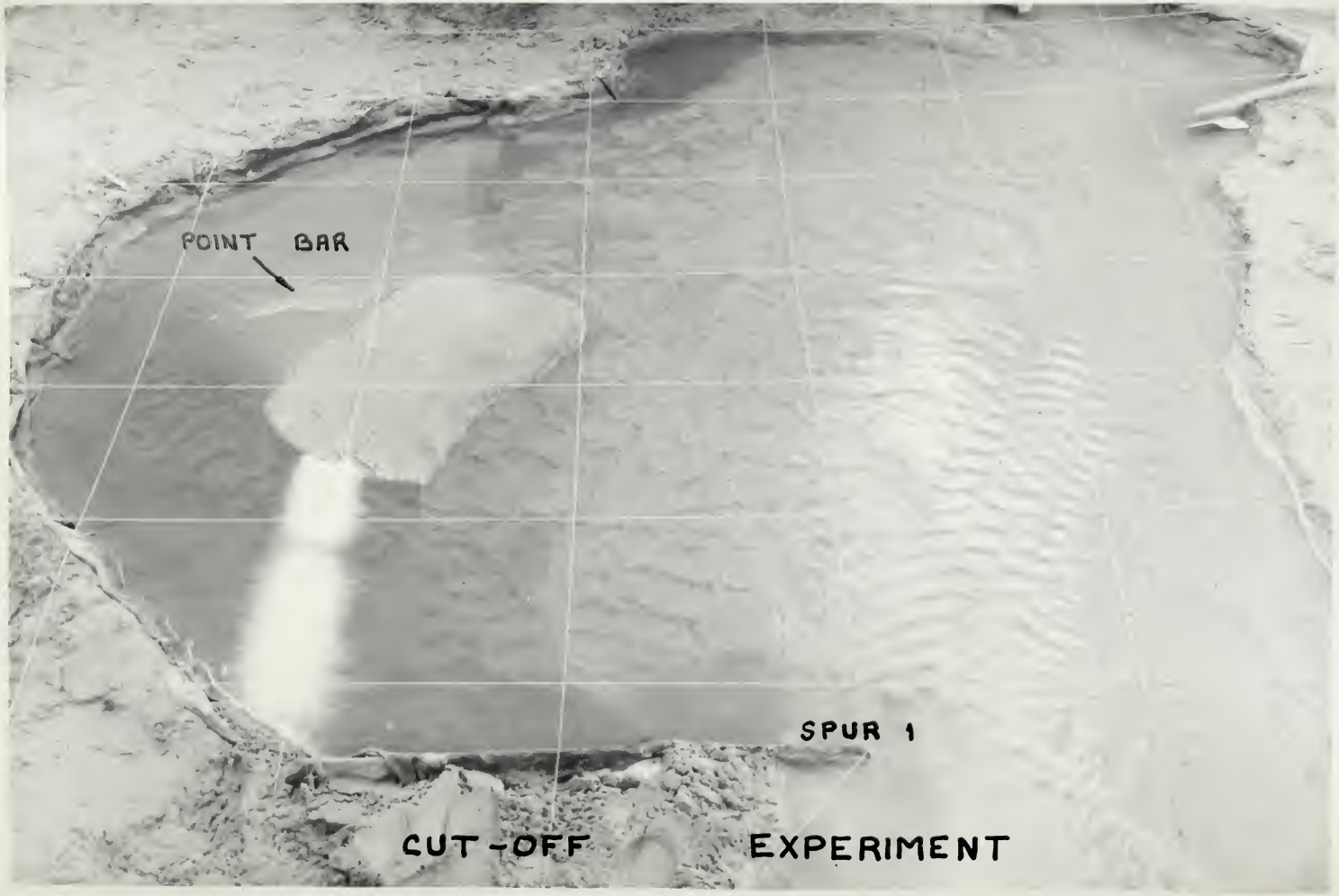
TIME = 8.6 HRS. Q = 0.45 CFS. FIG. 83



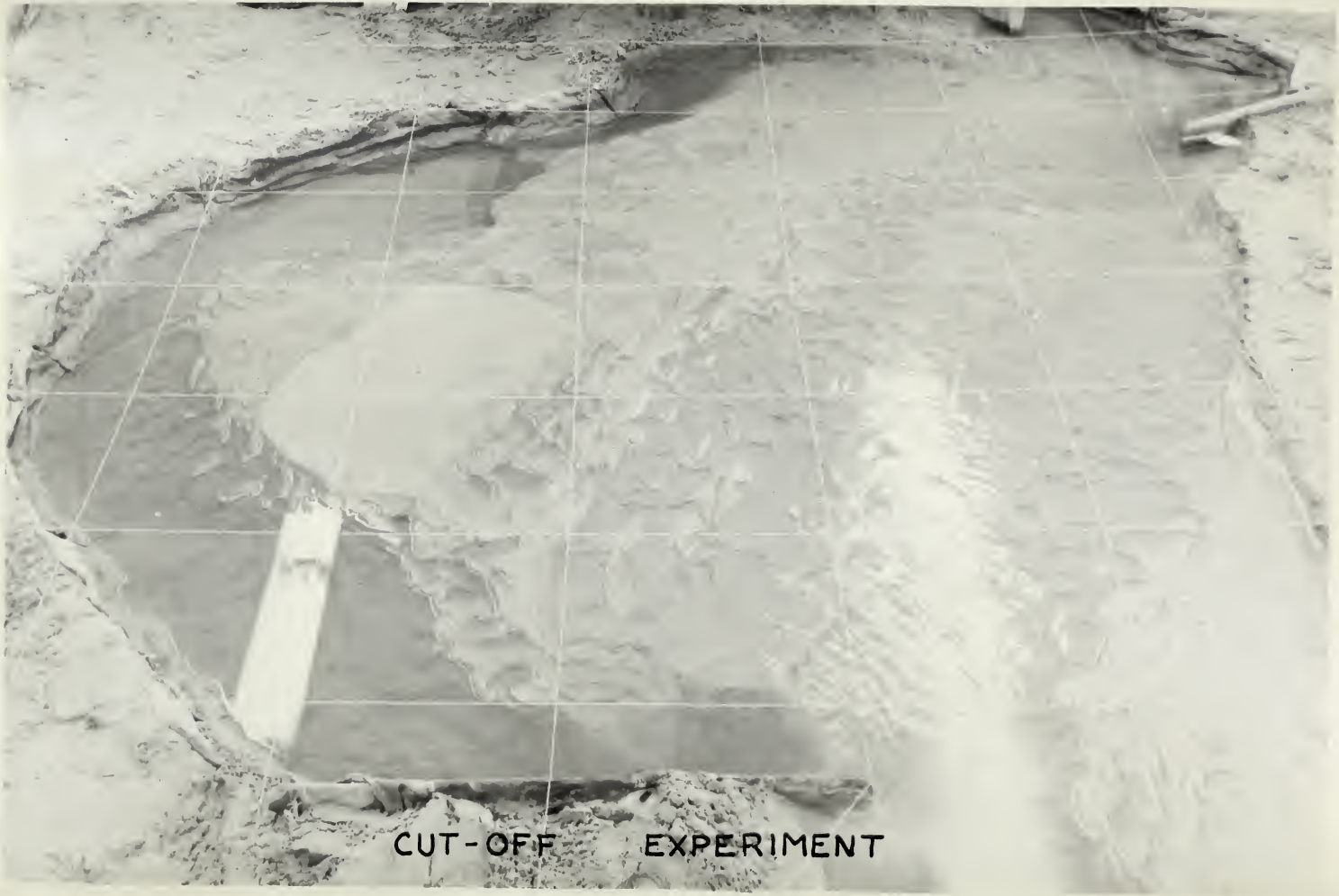
TIME = 9.1 HRS. Q = 0.45 CFS. FIG. 84



TIME = 11.1 HRS. Q= 0.45 CFS. FIG. 85

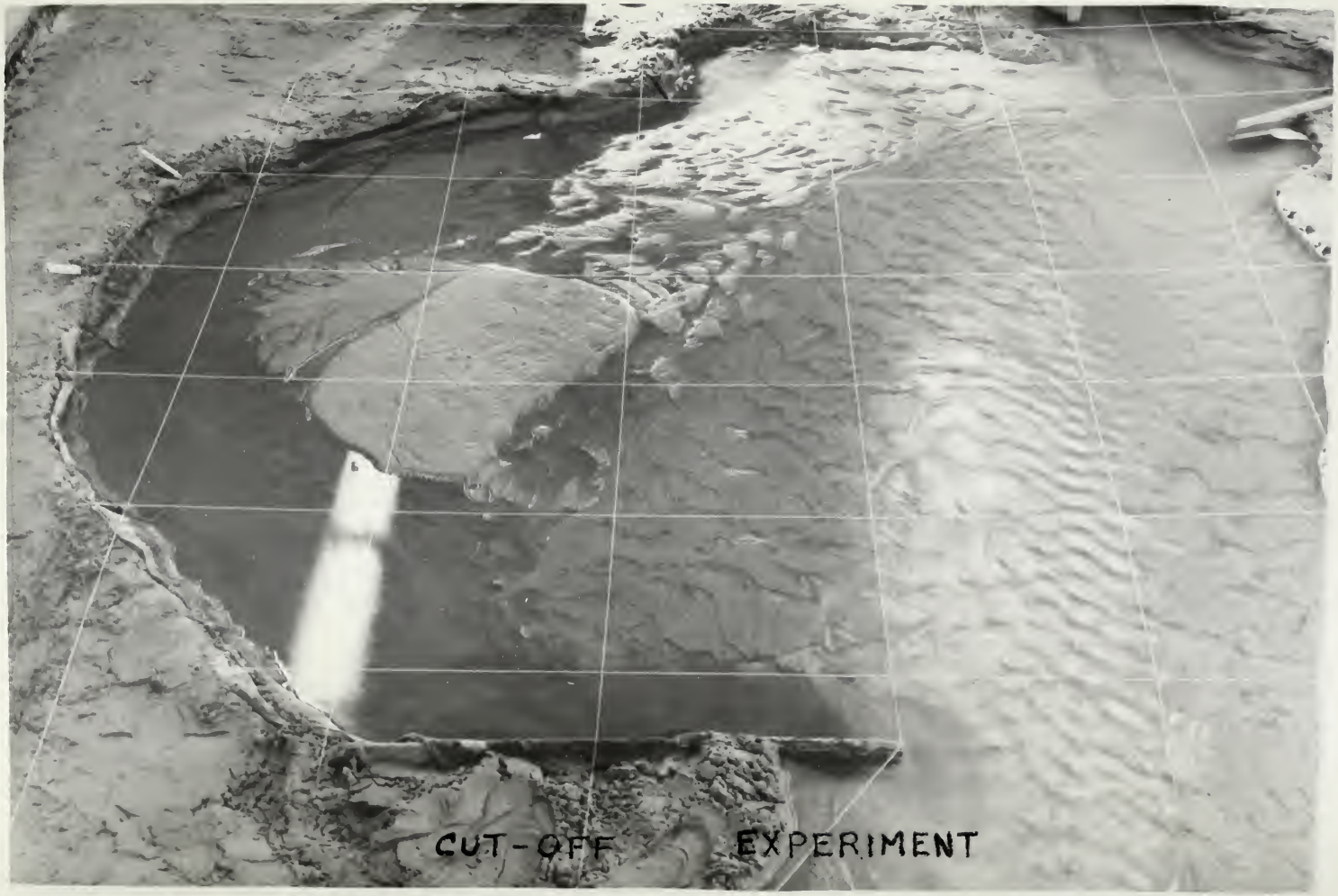


TIME = 14.6 HRS. Q = 0.45 CFS. FIG. 86

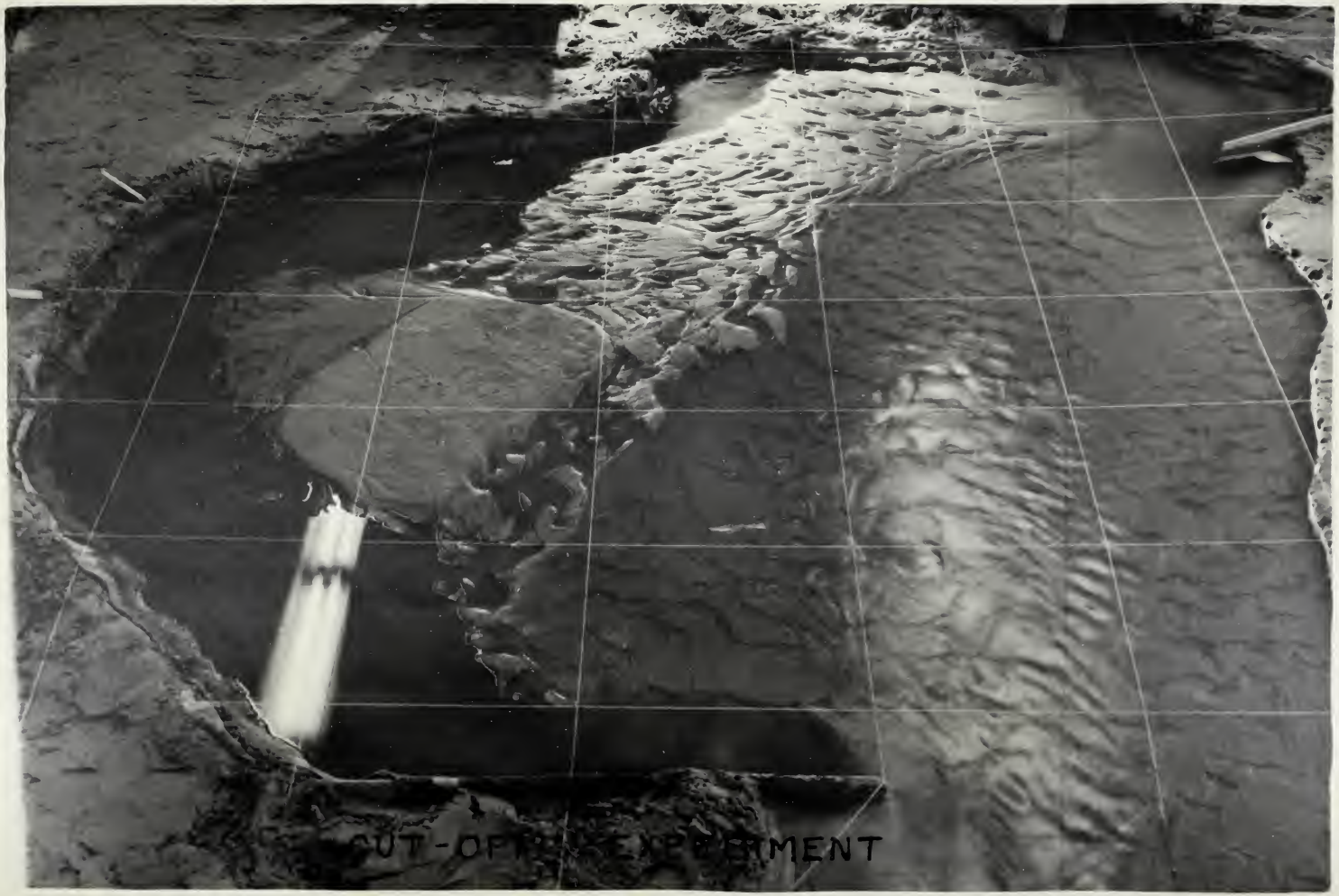


TIME = 14.7 HRS. Q = 0.09 CFS.

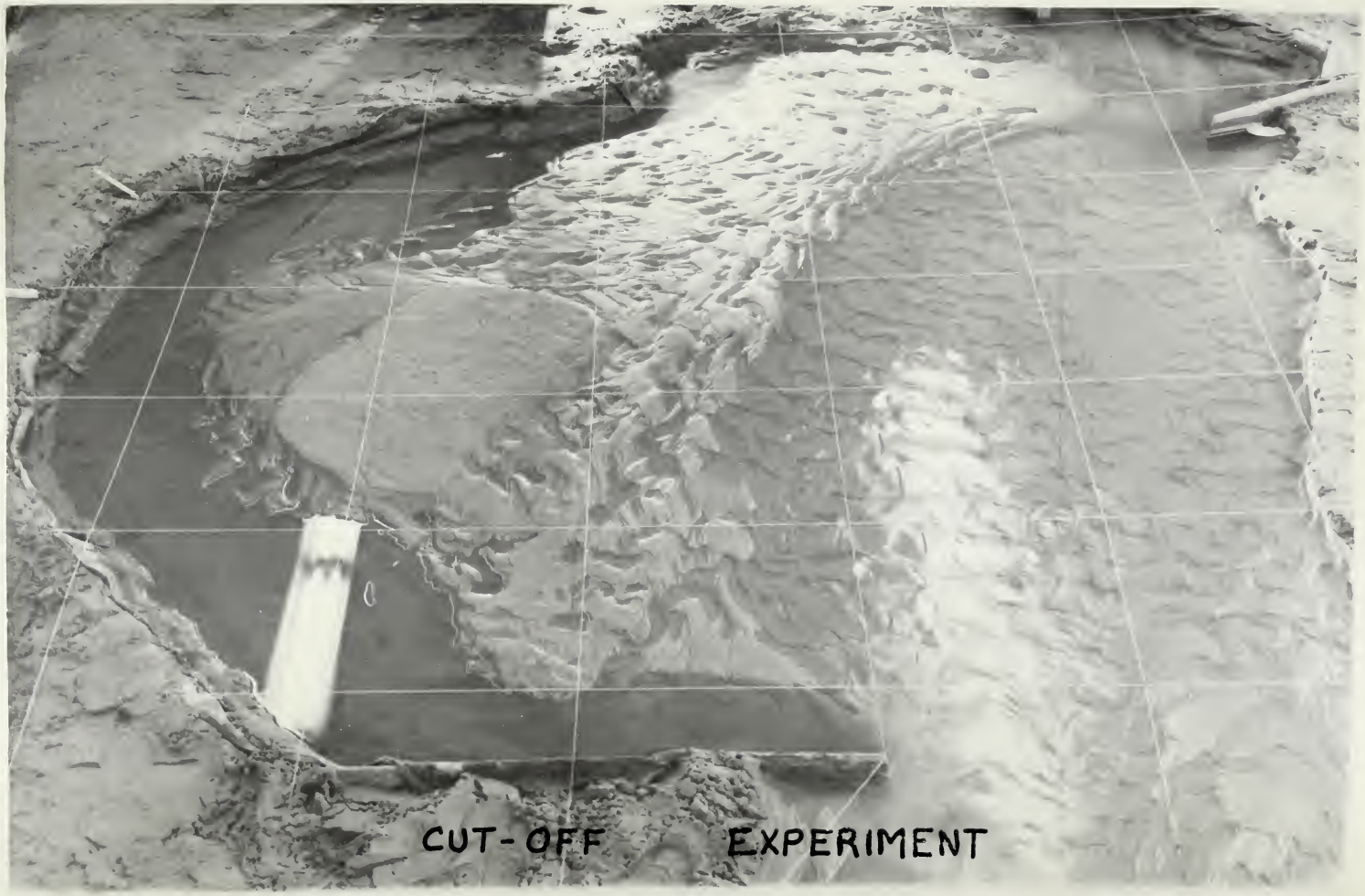
FIG. 87



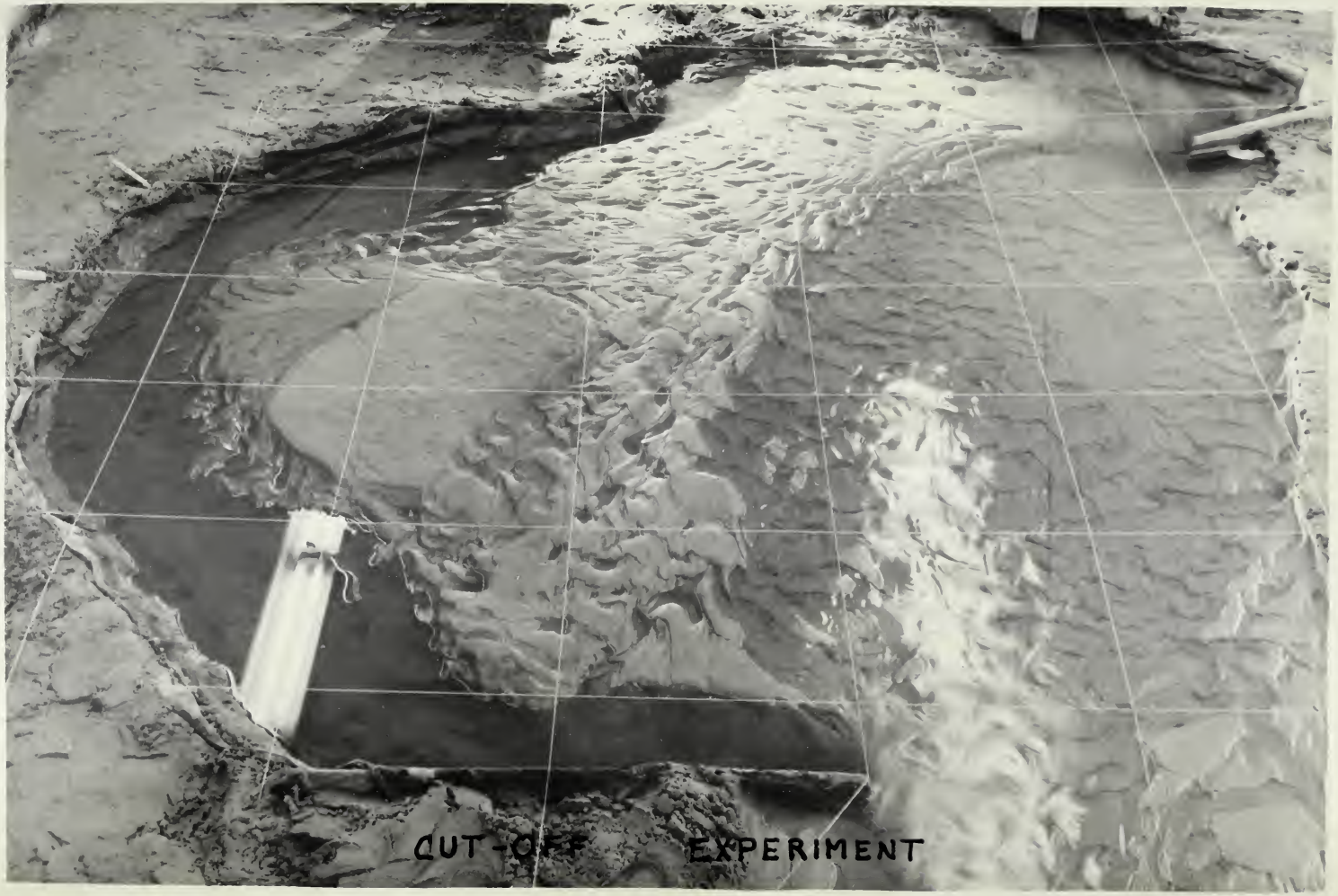
TIME = 21.1 HRS. Q = 0.45 CFS. FIG. 88



TIME = 21.2 HRS. Q = 0.22 CFS. FIG. 89

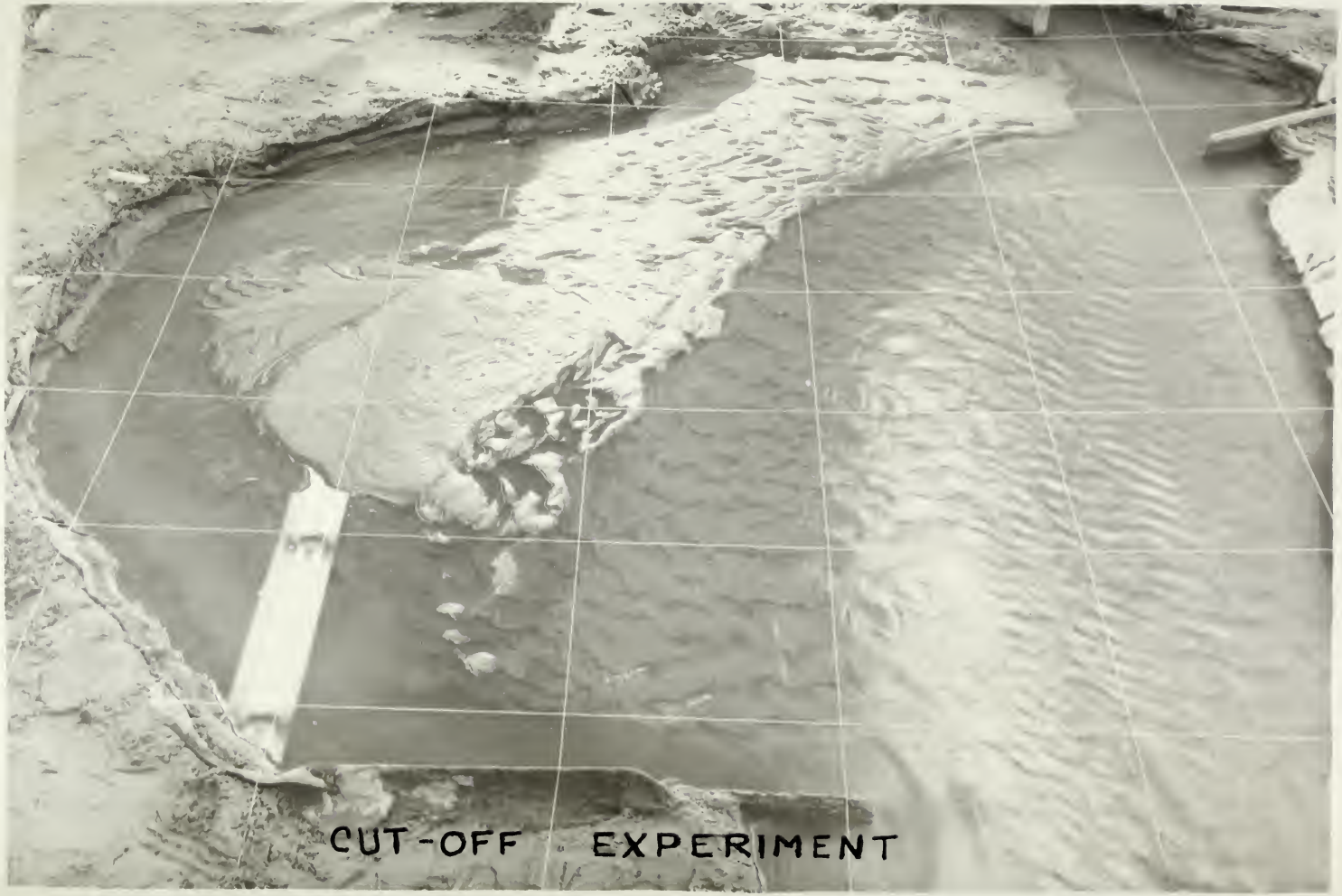


TIME = 21.2 HRS. Q = 0.09 CFS. FIG. 90



TIME = 21.2 HRS Q = 0.045 CFS. FIG. 91

TIME = 29.2 HRS. Q = 0.45 CFS. FIG. 92



TIME = 35.6 HRS. Q = 0.45 CFS. FIG. 93

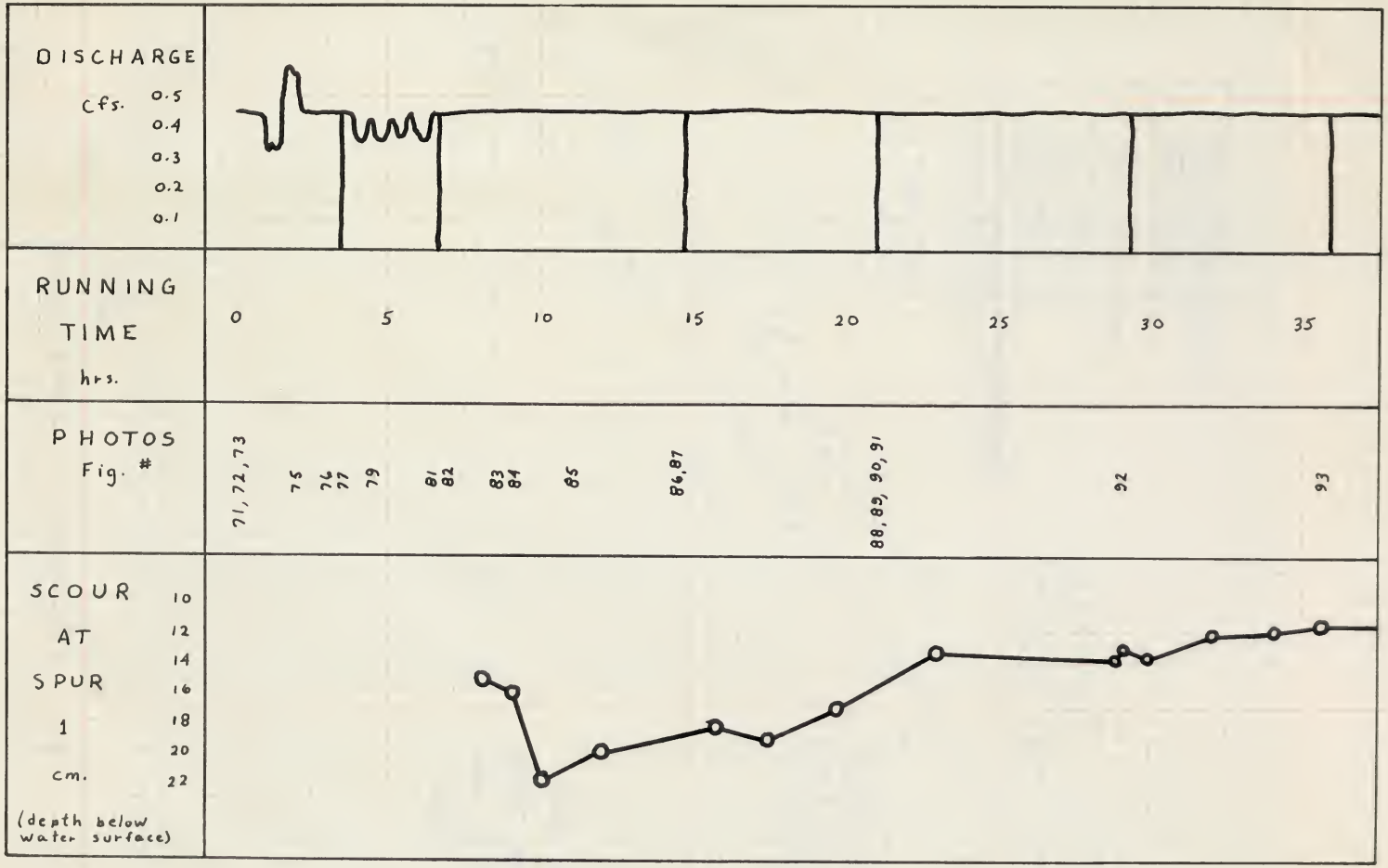


Fig. 94

CHRONOLOGY OF CUT-OFF EXPERIMENT

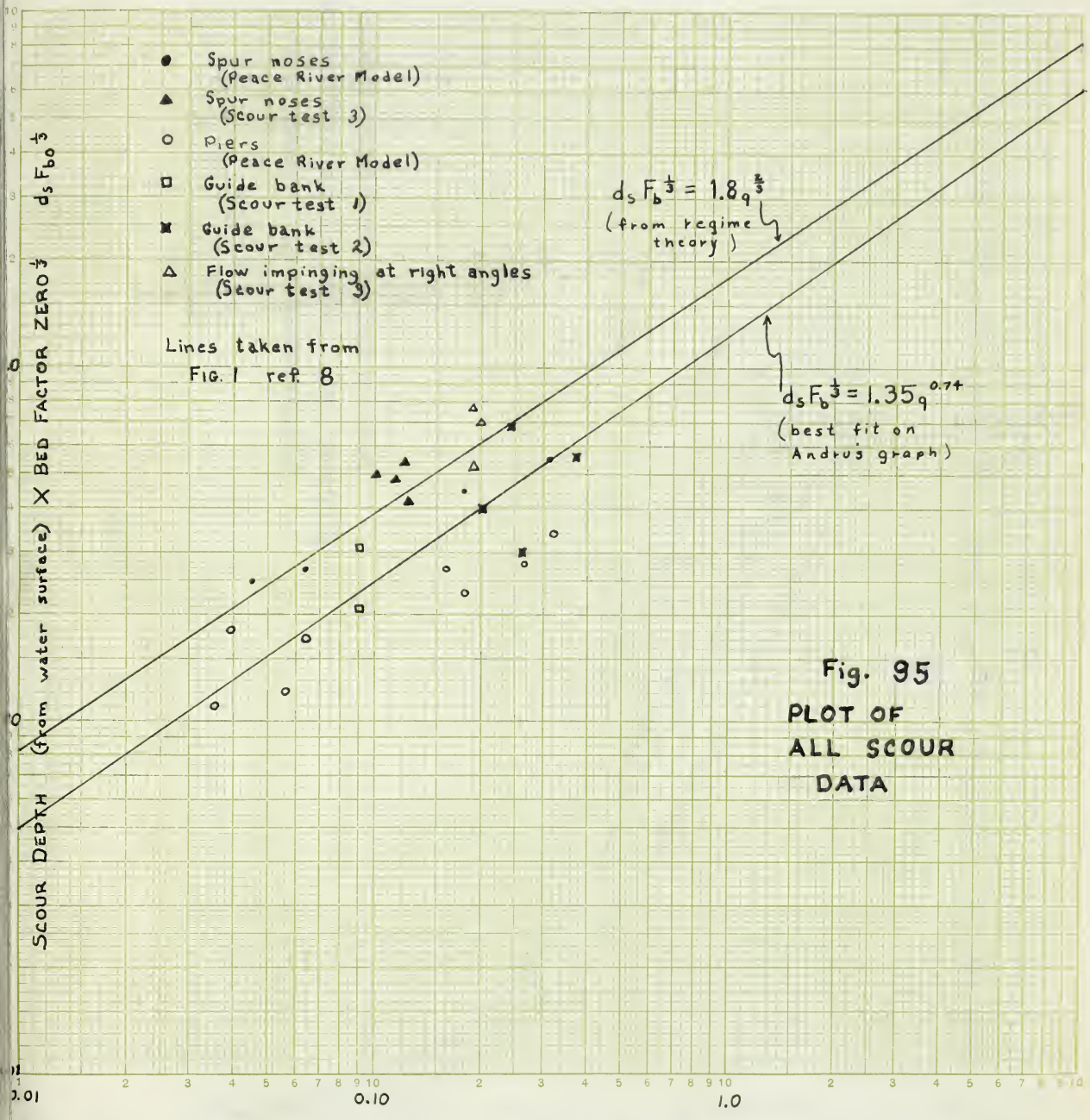
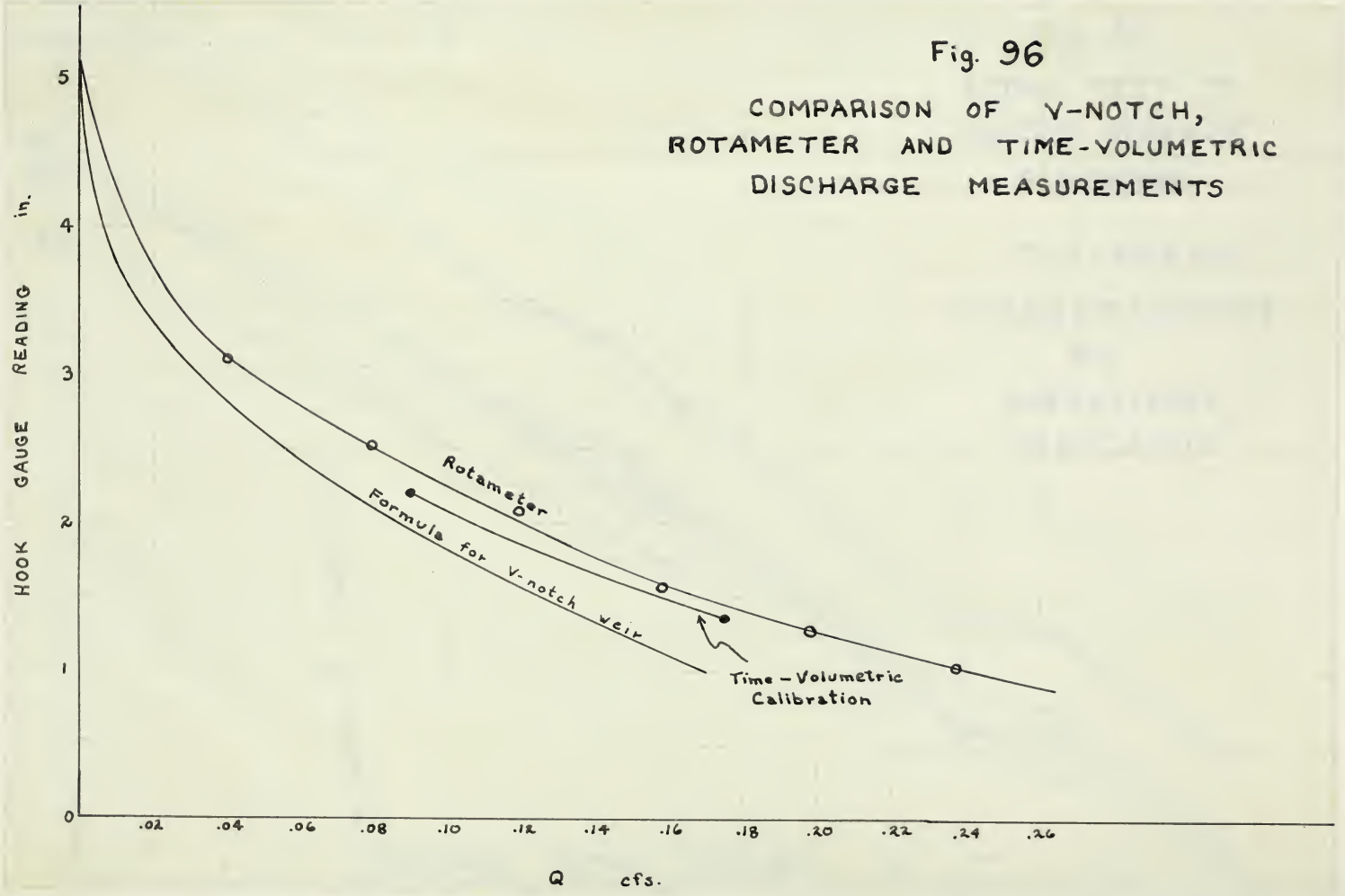
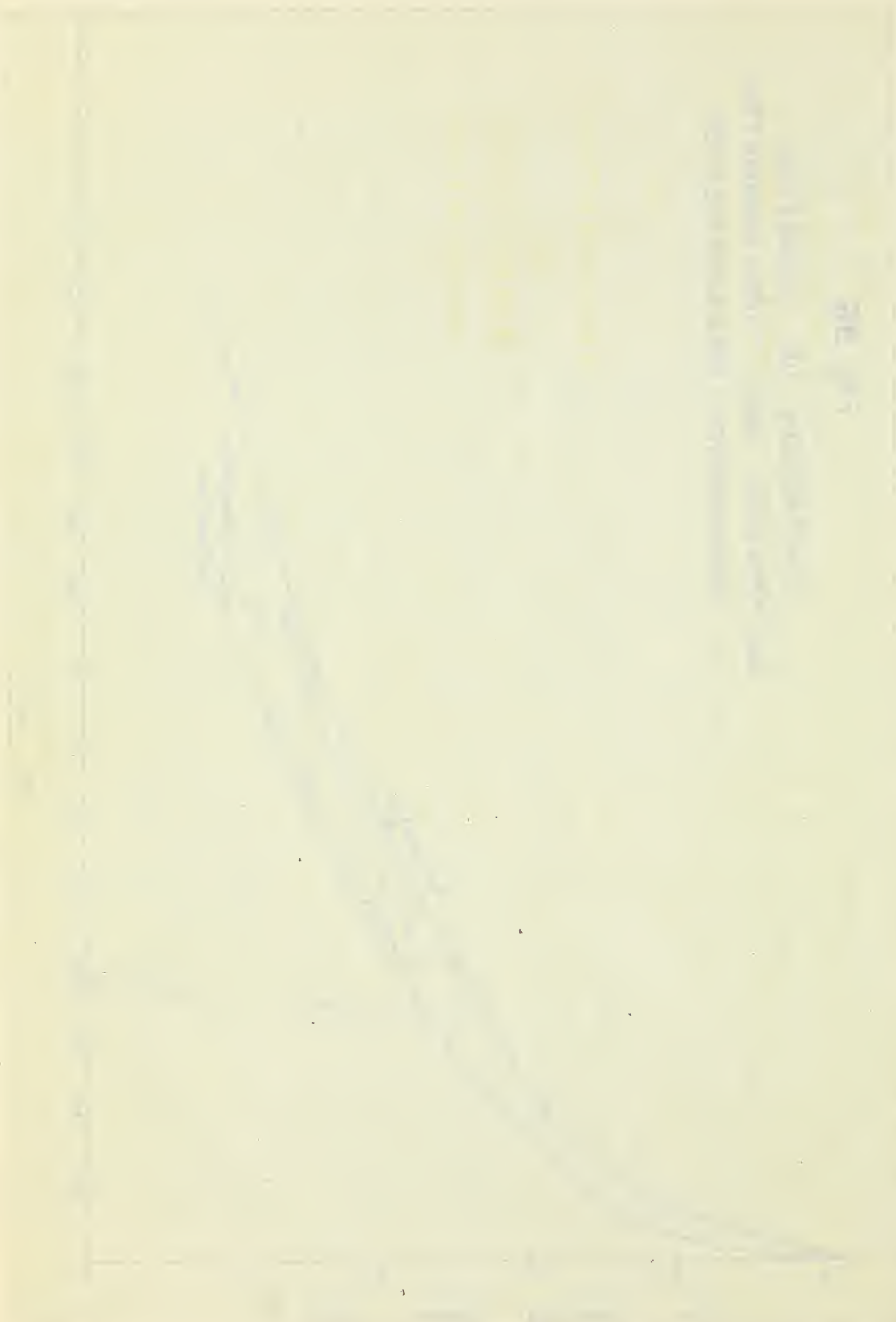

Spur noses (Peace River Model)
Spur noses (Scour test 3)
Piers (Peace River Model)
Guide bank (Scour test 1)
Guide bank (Scour test 2)
Flow impinging at right angles (Scour test 3)
Lines taken from Fig. 1 ref. 8
$d_s F_b^{\frac{1}{3}} = 1.8 q^{\frac{2}{3}}$ (from regime theory)
$d_s F_b^{\frac{1}{3}} = 1.35 q^{0.74}$ (best fit on Andrus graph)
$d_s F_{bo}^{\frac{1}{3}}$
SCOUR DEPTH (from water surface) X BED FACTOR ZERO$^{\frac{1}{3}}$
0.01
0.10
1.0
DISCHARGE INTENSITY q c.f.s./ft.

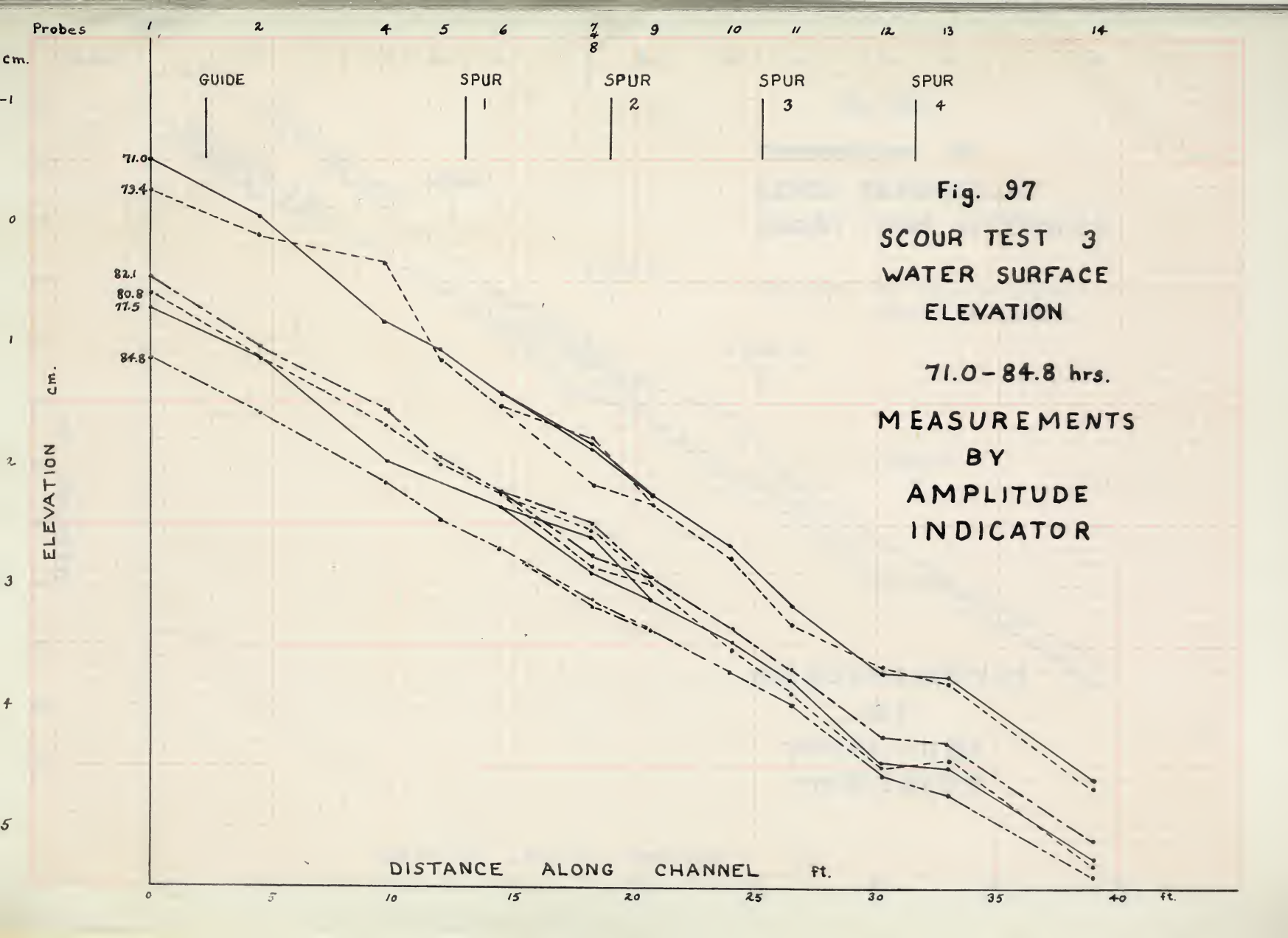
Fig. 95
PLOT OF ALL SCOUR DATA

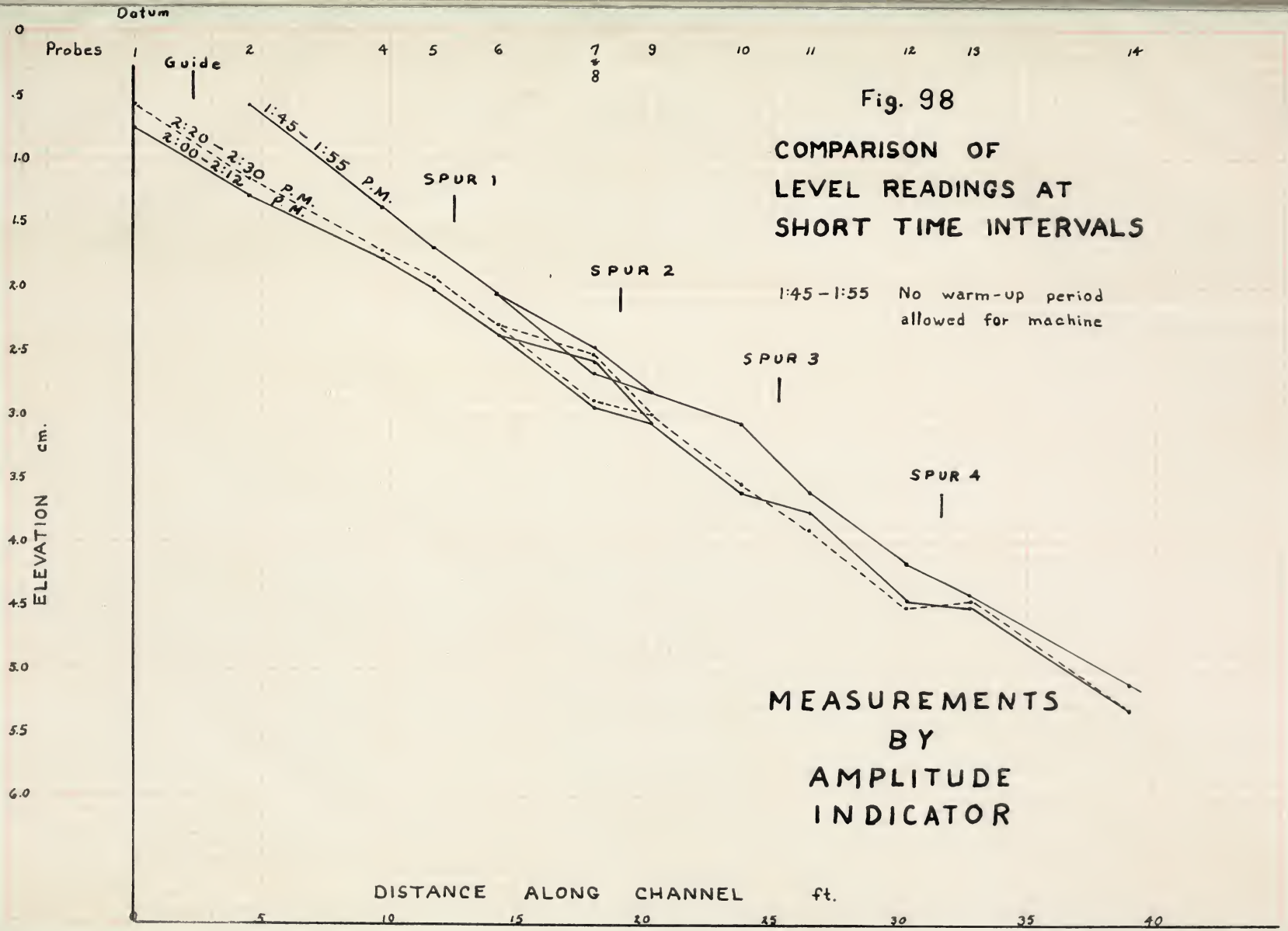
Fig. 96

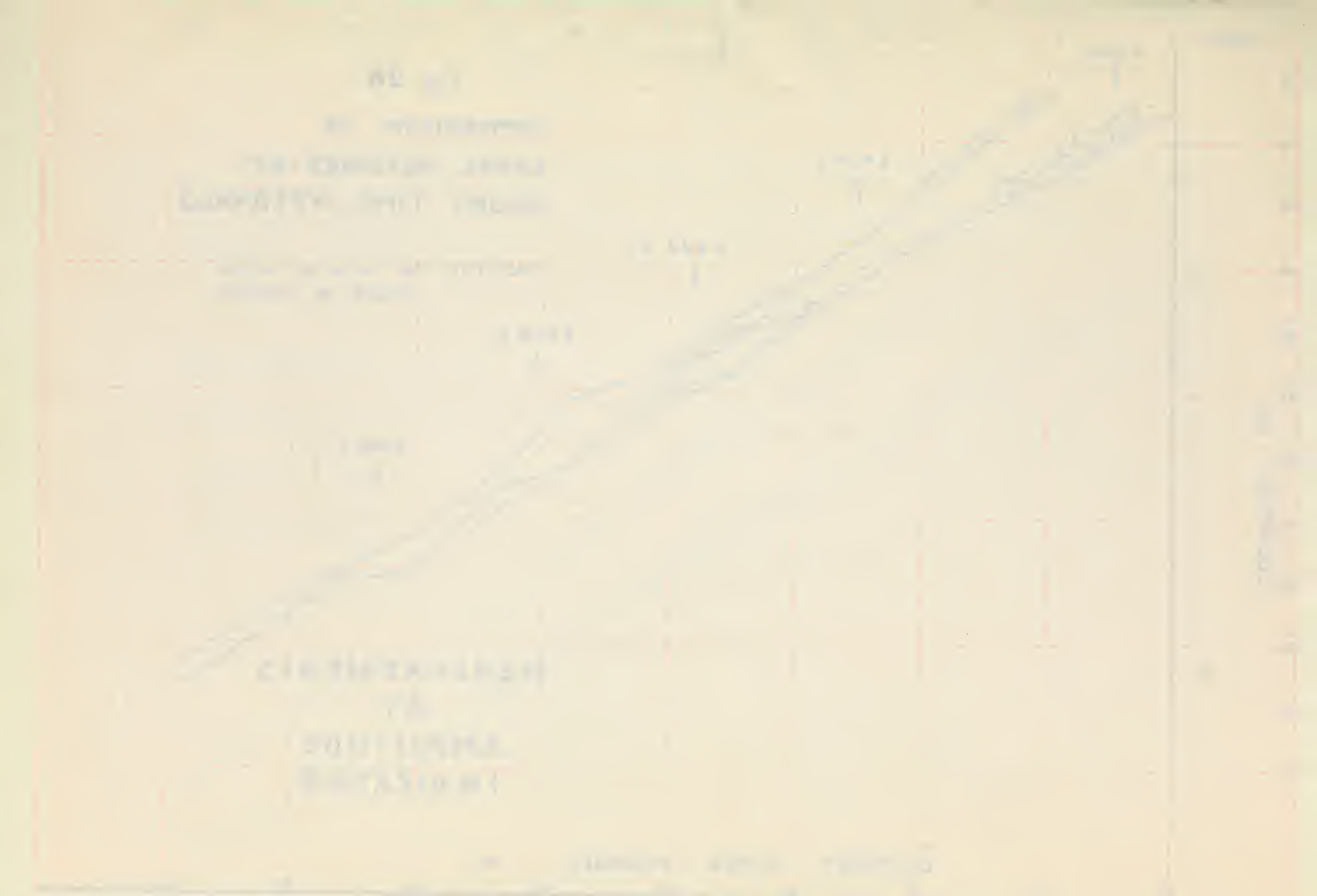
COMPARISON OF V-NOTCH, ROTAMETER AND TIME-VOLUMETRIC DISCHARGE MEASUREMENTS






Probes 1 2 4 5 6 7 8 9 10 11 12 13 14
cm.
-1
0
1
2
3
4
5
GUIDE
SPUR 1
SPUR 2
SPUR 3
SPUR 4
71.0
73.4
82.1
80.8
77.5
84.8
ELEVATION cm.
DISTANCE ALONG CHANNEL ft.
0 5 10 15 20 25 30 35 40 ft.
Fig. 97
SCOUR TEST 3
WATER SURFACE
ELEVATION
71.0 - 84.8 hrs.
MEASUREMENTS
BY
AMPLITUDE
INDICATOR


Datum
0
Probes
1
Guide
2
4
5
6
7
8
9
10
11
12
13
14
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
ELEVATION cm.
1:45 – 1:55 P.M.
2:20 – 2:30 P.M.
2:00 – 2:12 P.M.
SPUR 1
SPUR 2
SPUR 3
SPUR 4
Fig. 98
COMPARISON OF
LEVEL READINGS AT
SHORT TIME INTERVALS
1:45 – 1:55 No warm-up period
allowed for machine
MEASUREMENTS
BY
AMPLITUDE
INDICATOR
DISTANCE ALONG CHANNEL ft.
0
5
10
15
20
25
30
35
40



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